JOTTINGS

ON COFFEE

ITS CULTURE

MYSORE,

GRAHAM ANDERSON,
MUNZERABAD.

BANGALORE:
PRINTED AT THE CAXTON PRESS,
10, SOUTH PARADE.
1879.

SB 269
A6

Carpentier

As mentioned in the introduction, I published in 1876, some of my remarks on Leaf Disease, &c., in Pamphlet form; but as such was only for private circulation among my friends and Brother Planters in this District; only one copy got as far as Ceylon. I have since frequently regretted the course I adopted and wishing to procure greater publicity and ventilation for the subject, which I cannot but consider of vital importance to all engaged in the Coffee enterprise; I recently communicated my views to the Proprietor of the Caxton Press, and I have now to place on record an expression of my grateful acknowledgements to that gentleman for having most liberally undertaken to print and publish my "Jottings" in a convenient form entirely at his own risk and for having relieved me of all responsibility in the matter.

G. A.

Barguai,
Munzerabad,
MYSORE.

A. I. L

444010

INTRODUCTION.

In apologizing for venturing on the consideration of the subjects referred to in the following pages I would wish to say that I consider much benefit is calculated to accrue to the profession to which I belong by others following my example. All that I have written in the Memorandum which these few sentences introduce, is intended more as a foundation for further consideration and research than as a positive enunciation of causes and effects, and I therefore hope that all faulty conclusions, all errors of conception and deduction, which may be discovered by those better informed may meet with calm forbearance and that the meagre attempt to unravel some of the mysteries which so sorely affect the interests of the planting community may meet during the process of criticism with that measure of indulgence which one man expects from another when voluntarily working for the common good. I would wish clearly to state that I have made frequent reference to, and obtained much valuable information from, the following standard works :—

Liebeg's Agricultural Chemistry
Anderson's " "
Cameron's " "
Greville's Algologia
Outlines of Fungologia (Printed by J. and C. Adlard)
Bohn's edition of the Bridgewater Treatises
Pilkington's Mechanics Own Book
Johnstone's Chemistry of Common Life

The Dictionary of Daily Wants
Enquire Within
A Work on Botany, without Title page
The Gardeners Chronicle
Half Hours with the Microscope (Lankester)
Professional Papers on Indian Engineering, Edited by Major Lang.
Amara Kosha, by L. Rice.

For the first chapter I unhesitatingly claim unlimited indulgence and as I am personally desirous of gaining information I have purposely flavored my remarks with, to me—the indispensable element of speculation, as I am not ashamed to confess that I know very little about the mysteries connected with the actual development of the fungi which constitute the diseases under consideration.

I may say that I am a firm believer in the maxim. "The utterances of the ignorant indirectly benefit mankind generally, as the wise man before he can correct an error has to lay bare the truth." Had Coffee Planting been an enterprise peculiar to the European Continent long ere this the fungoid diseases affecting it so ruinously would have engaged the attention of the whole scientific world; but as it is, these subjects have met with merely casual attention and this day the unfortunate Planter so far as the scientific world is concerned has not been favored with one practical hint as to what is the cause, or remedy for, the pests which annually ravage his Estates. "Self help" is a grand institution, and under its banner no one should be ashamed to engage in the combat. Leaf disease and Rot like all other fungoid diseases are profound subjects, but a man would be little better than a coward who would not risk even being styled a charlatan or an ignoramus to endeavour to assist to improve his own prospects and those of his brother cultivators. A skilled Phy-

sician is unquestionably a "ministering angel," but does a sick man resent the kindly attentions of a rough and ready fellow creature when no professional assistance is at hand? I fear no unkind remarks from my Brother Planters, and I have already claimed indulgence from the scientific world, and if in the process of exposing my utter ignorance any light is thrown on the obscure subjects under consideration I shall feel amply remunerated for my trouble. I have read recent accounts of the results of feeding cattle on the produce of sewage farms, and of the influence on the taste of milk produced by cows fed on grass grown on land manured with soot. I leave all my conclusions to be corrected, but I am strongly of opinion, that certain conditions in the soil will produce, or favor, the development of fungi in plants. The question may be asked why do not other plants and weeds growing on the same land suffer in a similar manner? I fancy the answer will be found by saying that their produce is not removed from the soil, and that not being cultivated, they only grow where circumstances favoring them exist. The fungi or parasites which affect man are different to those found in animals and each genus and species of plant have probably their own peculiar pests. Fungi and insects have each probably proclivities peculiar to themselves. The borer is supposed to be peculiar to coffee; but each jungle plant has its peculiar borer. The coffee bug is, I believe, different from that which attacks the Gua va. Probably certain conditions favor the appearance of certain pests and their non-existence can only be accounted for, by either, the absence of those conditions, or of their natural food. A coffee pest may be developed by perhaps a single tree, to assist which in its work of evil, every condition may be present—once formed a fungus, or a parasite, a bug, or a borer, would find no difficulty in living on trees, and under conditions even slightly below or above the standard of its requirements.

The development of the yeast plant is a subject well worthy of study, and any one who has read what Liebeg says on the subject, will like me begin, to think, that we know very little, generally, of a very important subject, and one closely allied to the one we are about to discuss.

I am aware that Leaf Disease sometimes appears earlier in the season and even during the rains, but I fancy this is merely owing to a plentiful supply of the fungoid spores being over, in the soil, from the visitation of the previous year. It is natural to conclude that when once the germs have been propagated, that subsequent reproduction is facilitated. I am however decidedly of opinion that the occurrence of the first and general visitation is contemporaneous with some peculiar stage of the process of *Eramacausis* which is favorable to the growth of the fungi and which is not of long duration, and if systematically attended to, might be averted altogether. A remarkable fact relative to mushrooms is well known to all natives, viz., that in the monsoon after thunder, one or two sunny days generally occur, and it is a common saying " it thundered to-day let us go for mushrooms to-morrow." Each fungus probably has its season, but also has its requirements and flourishes in an exaçt ratio to the suitability and quantity of its food. If what I surmise is correct, it will devolve on every planter carefully to ascertain the particular condition of soil during the prevalence of the pest, and endeavour to alter it and thus throw difficulties in the way of this mysterious visitation.

In the second and following chapters I must apologize for changing to the first person in addressing my readers, but such has been rendered necessary owing to many of my remarks having already appeared in the form of letters to the Press, and to save time in making a selection from such I have found it convenient to utilize the printed proofs.

JOTTINGS ON COFFEE
AND
ITS CULTURE IN MYSORE.

CHAPTER I.

THEORETICAL AND GENERAL REMARKS ON LEAF DISEASE AND ROT.

There are many circumstances connected with and attending peculiar phases in the life of man and plants which are analogous, but when considered minutely are found to be either brought about by very different causes, or by means of a mysterious nature. There are many however worked out in a precisely similar way, having both the cause and the effect distinctly traceable to well defined phenomena. In the first instance it is no doubt owing to the well ascertained facts, that certain things good for man are bad for the plants, and what is really food for the plant, is positively pernicious to the life of man. In the second instance such essentials as light, air, water and certain inorganic substances are as necessary to the being of a man as to that of a plant. However this may be, it is extremely difficult, and indeed, in some cases impossible, to regulate cultivation in practice, entirely according to data furnished, by experience, or agricultural experiments, as Nature as it were, always appears to be prepared to thwart the efforts of man by some hidden means, and man finds, that however carefully he may work, there is always some peculiar condition arrived at, which either induces, or actually produces, effects which call for scientific investigation, and chemical

research. The most celebrated of the London Physicians has written a work endeavoring to arrive at conclusions regarding the identity or non-identity of Typhus and Typhoid fever. For a scientific man there is a similar field for research open in a consideration of the identity or non-identity of the *causes* which induce Leaf Disease and Rot. Typhus taken generically would be classed as a malady attacking persons rendered predisposed by causes, which had reduced, or impaired, the vital energy of the system ; such as impure air, contaminated water, bad living and long exposure to alternations of heat and cold of any extraordinary character. The system of such persons is not sufficiently vigorous to withstand, or may even favor, the insidious attack, which comes on, to a certain extent, involved in mystery. There is not the slightest doubt that this type of maladies really belongs to the Fungoid class and as the spore is in the blood its elimination is a tedious process, Cholera and many other diseases are gradually being asknowledged to belong to the same class and contagion is supposed to be effected by the fungoid spores being carried about in the air or in the water The great aim of science in dealing with fungoid, or parasitic disease, whether as affecting the human or vegetable creation must be first on the principle of prevention being better than cure, and secondly when the disease has really arrived to endeavor to localize, and circumvent it, and to neutralize, and render harmless, the minute particles, which constitute the agency by which contagion is effected. Research tells us that the animal, vegetable, and mineral creations, are bound together by a system of reciprocal obligation so that one cannot get on without the other. The one has to depend on the other to form that state of complete harmony which characterizes the workings of Nature. The death and decomposition of one race, or genus, of plants form the food for subsequent reproductions. This applies to the vegetable

kingdom in a most apparent way, but the animal kingdom benefits by a similar process under most mysterious circumstances and peculiar conditions. Dead and decomposed vegetable refuse form the most valuable *general* food for plants, but it is a problem for science to solve whether the *mineral* constituents contained in such, or indeed even contained in a given soil, are sufficient for the production of crops known to contain a preponderance of mineral matter—Analysis of soils appears an indispensable operation.

We have arrived at the following conclusion. Decomposed animal and vegetable substances are good for the plant, but except under certain circumstances are poisonous to man. Under what circumstances does the animal creation benefit in regard to them. The answer simply is, that by their application as manure to plants the whole mass is transformed—the noxious principles undergo chemical changes, the plant is benefitted and through the pores of the leaves a gas is evolved which is continually vitalizing the atmosphere. Now for a plant to be able to grapple as it were with a poisonous substance and convert it into a life giving one for man and still benefit itself, its vital energy must be vigorous and unimpaired and the soil must come to its assistance with chemical agents, and must be mechanically in a condition to favor, the mysterious process, and it stands to reason that if the plant is unassisted thus, that, what would have tended to its prosperity, must be positively pernicious to it. The soil assisted by the atmosphere must as it were cook the food for the plant, and must do so thoroughly, otherwise the proximity of *semi-decomposed* vegetable matter must be as hurtful to the living plant, as a festering corpse is to a human being. If however the agents necessary for the *complete* decomposition of animal or vegetable matter be present, and be assisted by those conditions indispensable

for their complete reduction to their chemical component parts, as well as their transformation, by combination, and other processes, from hurtful substances, to wholesome compounds, liquids and gases; and if the organisms prepared by Nature for that especial purpose are available and eager, not only to assist, but actually to assimilate the product, we may say of what was bad, and actually produce and give forth good and life giving principles; then animal and vegetable matter by decomposition tend to create the means for increased vitality in both the man and the plant. But all must work together in harmony and each principle in vegetable, and animal, and mineral kingdom must be vigorous and ready to act according to the fixed laws of the peculiar reciprocal system of economy. One cannot do without the assistance and co-operation of the other and immediately one cr the other fails, universal disaster results. But man always checks Nature, and having taken the whole responsibility on himself, finds out too late that Nature is very apt to resent his interference. Let any one imagine a large City in a desert without trees or cultivation. The amount of matter and gases poisonous to man which would be formed both by decomposition of animal refuse and by the exhalations from the lungs and bodies of the people would be enormous. Large towns where drainage is neglected are proverbially allowed to be liable to visitations of Cholera and Typhus, and why? Man has upset the balance of Nature, has brought about an accumulation of poisonous refuse without thinking of the duty and power which trees and vegetation fulfil and exert in neutralizing the poisons collected and evolved. The same is more than likely the case with plants. If we grow a plant naturally containing in its composition a large amount of mineral constitutents and yielding a crop containing a very large percentage of mineral matter and go

on from year to year exhausting the available supply of mineral food in the soil and supply either nothing or perhaps vast masses of manure produced by grass fed cattle—or perhaps merely weeds leaves of trees grown on the spot, *without* carrying out mechanical operations calculated to favor *complete* decomposition; does it not appear probable that the plant must not only be starved but actually poisoned and its vital energy must suffer? The want of the mineral constituents has no doubt altered the condition of the soil, has deprived it of its powers, and the presence of the *partially* decomposed matter applied can only tend to cause absolute injury by its vitiating properties· The tropics are celebrated for the most violent alternations of temperature. Four months rain and six months fierce sun immediately after must be considered as proof of this statement. Hot drying winds during the day and cold dews at night are of frequent occurrence. The plant has to stand all this and may be surrounded both in, and out, of the scil, by the vast masses of semi-decomposed matter without perhaps any of those conditions calculated to assist the necessary chemical changes, or may be acted upon by noxious acid vapors arising simply from faulty condition of the soil. Must not all this be to the plant what ill drained cities are to man?

Land that has been *superfically* worked and long exposed to atmospheric action always gets covered with moss or creeping weeds, loses its granular form, and becomes clogged. The soil after a time becomes cold and surcharged with all sorts of acidity and noxious gases. Decomposition of organic matter is *checked* and "humus" is formed and if such is of the insoluble kind the plant has to eke out a wretched existence surrounded by a clammy mass of soil and organic matter in a form alone favorable for the formation of pernicious combinations. It becomes preyed on naturally

in this debilitated state by insects, and fungoid diseases, and man wonders what is to be done to avert the calamity.

The unfortunate planter seems doomed to have his estates visited by all sorts of pests which can only be grappled with by the expenditure of fresh capital. Every year shows him he is becoming more and more dependent on science. A man may cultivate for a certain period, and have a fair amount of success, but after a time the cultivation resolves itself into a science to master which research, experience, and chemistry, must go hand in hand with capital and energy.

The difference between the Leaf Disease and the Rot is that the former is a fungoid disease originating *in* or at least affecting the cellular tissue, and causing a fungoid efforescence or *eruption on* the leaf; whereas the Rot is a fungoid deposit from *without* assisted by the impaired condition of the system of the plant. Leaf disease under the miscroscope is found to consist of innumerable minute fungi which are forced out of the pores of the leaf, whereas the tenacious fungoid web which in "Rot" completely creeps over the lower suface of the leaf, is evidently a mildew deposit, caused by atmospheric action, coupled with a passive submission of the leaf to the insidious attack, owing to the vital energy of the plant being impaired. In the Monsoon all inanimate substances are attacked by mildew, and is it difficult to realize the probability that a plant, with impaired vital energy, and struggling for food in a cold retentive soil, containing noxious gases stagnant water and a mass of matter highly suitable for growing mushrooms and fungi and perhaps in a mouldy and mildew state, should also be liable to similar attacks? Now allowing what has been said, (making every allowance for ignorance and faulty argument) to have a certain amount of truth in it, we ar-

rive at the great object of our inquiry—What is the planter to do to rid his trees of these pests? All outward applications must be considered as useless, first because of the labor of applying them, and the chance indeed the certainly of their being washed off in the rains, and secondly as their effect could only temporarily affect the condition of the plant.

Agricultural chemistry distinctly tells us that the process of decomposition of vegetable matter in the soil is not only gradual, but that before ultimate decomposition can be effected the substance has to pass through various phases and that peculiar mechanical conditions of the soil either *accelerate* or *retard* the process and that indeed under certain circumstances such may be *completely checked*, and that certain products may *accumulate* to such an abnormal extent as to prove positively pernicious. Liebeg comments at great length on the technical difference of *fermentation*, *putrescence*, and *decomposition* and explains the various phases that matter passes through during such processes. Professor Anderson says, "at one peculiar stage of the process of disintegration—vegetable matter is converted into either Humin or Ulmin, both, of which are insoluble in alkalies, that further on, the products become soluble in alkalies, and contain humic, ulmic and geic acid, and finally by a continuance of the wonderfui process, crenic and apocrenic acids are produced." The accumulation of Humus in any soil may be favored by many circumstances among which must be conspicuous faulty mechanical condition and the exhaustion of the mineral constituents. After a soil has been long superficially worked, as we found before, it lose its granular form and becomes clogged; vegetable matter contained in, or buried in such a soil, is hermetically sealed against the entry of Oxygen, and consequently the decomposition of the substance is materially impeded and if other

conditions are present may remain in either the humin and ulmin—or the acid stage for so long a time as to cause serious inconvenience to growing crops. Again when a soil has been persistently cropped with the same genus of plant, certain ingredients in the soil are exhausted sooner than others, and if this condition is not discovered and attended to, all sorts of disasters may result. However rich the soil may be in other respects, the absence of a sufficient proportion of a special ingredient, or constituent, will nullify all efforts aimed at improvement, until such abnormal condition is counteracted. Rotation of crops has been instituted in order to prevent such exhaustion, and the benefits derivable from the institution of fallows have been long apparent even to the uneducated native. It is a known fact that the potato disease is favored, and even probably induced, by a persistent cultivation of that plant on the same soil for a number of years consecutively —in fact upon a "potato-sick soil." Strict attention to the principles of the rotation of crops is the only remedy, and if such is impossible, beneficial results are even likely to be produced by a careful and systematic change not only of seed but of the variety.

Mushrooms and fungi are a very low order of plant and do not grow on vegetable matter which has passed through the ultimate process of decomposition, but seem to flourish under circumstances favoring the maintenance of a peculiar *intermediate* stage of decomposition which is favorable to their existence and development; and it appears that this particular and requisite phase may be either *prolonged* or *shortened* by chemical applications, and mechanical operations. Now we arrive at a conclusion that the undue exhaustion of individual ingredients of a soil and faulty mechanical condition of such soil are calculated to induce, or favor, certain abnormal conditions and that at *particular*

stages of decomposition results are produced eminently calculated to favour the growth and development of fungi. The constitution of a plant suffering from a want of special element must be more susceptible to the attack of fungoid or parasitic disease than one in robust condition and surrounded by every element of plant food in a suitable and available form to build up, and maintain, its constitution in vigor. A plant like an animal may go on yielding, but, that does not necessarily mean that its constitution is not becoming gradually impaired. A Cow may continue to give milk in certain quantities; but such may be daily decreasing in nutritive value. A coffee tree may continue to yield crop after crop; but who can, without a scientific analysis, determine, the relative proportions of Lime. Potash and Soda which are wanting in the composition of the bean in each successive crop?

Plants have frequently been experimentally grown and have produced a crop, in a strictly artificially made substitute for the soil from which many ascertained food requisites were purposely omitted, but the system of plants under a continuance of such circumstances could not possibly be maintained in vigor.

Leaf disease appears just after heavy rain, at the advent of fair weather. It only lasts a limited time and entirely disappears to return under similar circumstances. Is it unreasonable to conjecture that the period of its appearance is contemporaneous with those peculiar or special phases of the decomposition of vegetable matters in the soil, namely either the humin and ulmin, or the acid stages. With the advent of fine weather the soil becomes less cloggy and more capable of allowing the entrance or exit of those gases which either retard, or accelerate, the necessary but mysterious process. If this conclusion has any truth in it, the remedy for leaf disease is not to be found in any outward

application ; the cure must be one affecting the cause ; the disease must not only be eliminated from the system of the plant, but from the soil also. If weeds and rubbish are to be buried, such should not be done merely to get rid of them, but to benefit the condition of the soil and every means must be adopted to insure their becoming useful, as they are not ornamental.

They must not be hermetically sealed up in a small hole, cut cheese like, in a cold retentive soil but, should be mixed generally with the soil, an operation which will make the land friable and rich at the same time—decomposition will not be checked and the trees will be generally benefited. A sample of *partially* decomposed vegetable matter found during digging in a cold sour retentive soil after 80 Inches of rainfall clearly shows what sort of food the plants have in their proximity. This substance is composed of leaves of forest trees, twigs and general debris and is found to be completely bound together with fungoid filaments. Immediately it is broken up, exposed to the air and generally mixed with soil it changes its appearance and the fungus disappears—does this prove that the food for the fungus has passed into a more advanced stage and has become food for a higher order of plant ? I cannot help thinking that the cure or at least mitigation of the fungoid pests is to be brought about more by mechanical operations, coupled with the application of manurial dissolvents than by any other means. Lime, Potash and Soda coupled with digging, draining, pruning and handling, are certainly among the most probable remedies for these most ruinous pests. Any remedy must go in at the root and must be placed in, and affect the soil. The plant should be treated as a human being. First let us equalize the circulation of the blood (sap) secondly invigorate its constitution with suitable food and tonics (mineral and nitrogenous manures) and by mechanical means convert the soil into a state which will favor and

not retard the operation of GRADUAL, but unceasing decomposition, of organic matter and render the existing mineral constituents available, and supply deficiencies. The sun's rays will then be utilized in promoting development of tissue instead of being entirely employed, in evaporating the stagnant moisture, charged with acid and poisonous gases. Systematic pruning and handling are the only operations calculated to equalize the circulation of sap. Planters must spend more money and bestow more attention on these operations.

Mr. Robertson in his essay on the agricultural condition of the Neilgherries recommends that more manurial, and less handling, operations should be carried out. The planter alone can judge as to the requirements of his particular locality. Where handling is in any way neglected in a rich Soil and *forcing* climate the whole energy of the plant goes towards making new wood, the trees look verdant and promising, but those alone who have paid for their experience can speak as to the disappointment in results. Too much care, it is generally considered, cannot be taken in the selection of shoots. None should be allowed to remain which emanate from bark bound secondaries whose surface is covered with moss and scales. A good thick vigorous shoot growing on a juicy twig of either primary or secondary formation should be selected, and once chosen should be carefully attended to. Under a judicious system of pruning and handling, Nature will remove moss and scales on the stem and principal branches in the course of a very short time and when the bark becomes clean, smooth, and dappled with green, vigorous circulation has been restored and the plant can generally take ordinary care of itself. Each new or extra shoot however small, carelessly left, or allowed to grow, out of the same eye, or even, in proximity to the selected shoot, tends to upset the regularity of circulation, the

sap occupies itself in trying to force itself into the more tender of the two and the development of the selected one is retarded, the cellulartissue becomes tough and prematurely contracted and offers obstacles to free and uninterrupted nourishment. It would appear that heavy pruning—particularly if *frequently* practised and followed by *careless* handling, gradually enfeebles the circulation of sap and has a decided tendency to upset its equal distribution;—such is clearly proved by the appearance of *"Gormandizers"* on one portion of the tree and sickly shoots on another.

The premature contraction of the cellulartissue caused by drought or check of any kind is plainly manifested in a hastily grown plant where suckers are thrown out perhaps half way up the stem, or even from the bottom—*before* the plant has even been topped.

Manures of every description must of course be liberally applied, but every *mechanical* operation calculated to favor the process of assimilation must be carefully attended to. The application of such manures as Lime, Potash, and Soda appears highly desirable both for chemical and physical purposes. They neutralize all the noxious and acid properties in the soil and directly enter into the composition of the crop and further exert a marvellous mechanical action on a cold or clammy soil making it sweet and loose and assisting Nature to transform organic substances and humus into good and wholesome food for the plant instead of remaining in a condition calculated to injure it. Poonac mixed with wood ash and bone dust, acts as a wonderful tonic application to coffee, but would be unavailing if not followed up by a really sustaining manure. Wherever from unavoidable circumstances or the visitation of any fungoid pest any danger is anticipated, capital should be freely expended first on energetic manual operations and then on the application of such mineral manures as a scientific investigation of causes and

effects shall show to be absolutely necessary to recover the balance of Nature. By far the best method would of course be to anticipate all probable difficulties by the regular and sysmatic application of a compound manure made on scientific principles and containing the principal *mineral* ingredients of the crop; but as most land on which estates are made is allowed to contain a vast store of essentials for the growth of Coffee, much money and labor might be uselessly expended unless the composition was made in connection with an accurate analysis of the soil. It therefore rests with each individual Planter to watch with a careful eye not only his own cultivation, but the operations of his neighbours; to make such arrangements, and to apply such adjuncts, as from time to time his experience and intelligence shall show him his land requires, or may require. Experiments, and their results, should always be carefully noted for future guidance and precursory appearances, symptoms or signs should always receive that prompt attention which they deserve.

The ground must be *deeply* worked. Digging, draining and the burial of surface matter and green weeds are indispensable; but each operation must be *systematically* performed with the *objects* of maintaining the texture and condition of the soil in a proper state; of rendering its properties available; and of making its temperature more uniform. The feeder roots will then collect food at a comparatively lower level than formerly, and the tap-root instead of remaining stationary, will force its way into a rich subsoil, and will enrich the plant with nutriment which would otherwise have never been utilized.

Deep digging and draining, dry the surface, but protect the sub-soil from the effects of drought, all the roots penetrate deeper in search of food and moisture and consequently in a well worked soil a plant is as green in the hot weather as in the rains,—a healthy circulation of sap is always going

on and the plant being generally robust and vigorous is better able to battle against all pests. A caked and wet soil soon cracks in the hot weather,—like cotton soil,—and the tender roots are frequently snapped just at a time when every available root is wanted for the support of the plant. A wet and retentive soil also prevents the air from entering it by the body of water it contains; chemical decomposition is retarded or entirely checked, and as was noted before, the formation of noxious combinations is favored. Both the organic and inorganic substances are liable to be injuriously influenced; for example most soils contain iron and it is clearly ascertained that during the process of decomposition this mineral in soils very rich in vegetable matter and especially in faulty condition, is very apt to pass from a peroxide to either a protoxide or sulphuret stage; combinations not only pernicious to all plants, but which are very liable to remain in an unchanged form for years. The *Humate* of iron is the most familiar example of this class of combination and is generally to be seen in the form of an unctuous exudation of a rusty color on the surface of badly drained soils.

Excessive irrigation *without* drainage is undoubtedly the cause of the calamity which has attended our irrigational operations in Bengal, where a saline deposit is formed on the surface which makes the land barren. The simple cause is, the soil was saturated with water having an affinity for, the salts contained in the soil, draining was not attended to the sun consequently had to dry the soil alone and unassisted by man and during the process of evaporation the water brought to the surface, held in solution the salts, and passing off in vapor, deposited them in a crust on the surface. Let the ground be stirred with subsoil plough and let a regular system of drainage go hand in hand with manuring and irrigation and we shall never hear of such disastrous failures.

Draining is to the subsoil what digging is to the surface and when once land is opened, up kept in a friable and porous, yet, firm state—Nature comes to man's assistance every particle of manure, each constituent of the soil, is in available form as food for the plant or is ready and able to perform its quantum of usefulness—every shower of rain takes life into the soil and expels all sour air, which it contains, making room for constant fresh supplies of OXYGEN, without which the soil to all intents and purposes is dead. If the estate be shaded, lopping and thinning must always be carefully attended to and the Planter must by his own energy and capital carry out such other operations as from time to time his experience may dictate or which the peculiar requirements of aspect, elevation and locality shall render necessary.

CHAPTER 2.

A PRACTICAL VIEW OF LEAF DISEASE AND ROT, AND CONCLUSIONS ARRIVED AT BY EXPERIENCE.

In commencing an investigation of a parasitical fungus like Hemilia we naturally search diligently for information connected with the details of its life history, development and requirements. Failing in this respect we look for axioms and definitions applicable to pests of a kindred nature. We are disappointed however at the outset, we find that the whole subject is shrouded in mystery, information is vainly sought for,—books are read and re-read; all around are difficulties, and one toils through a labyrinth of technicalities and puzzling phraseology vainly seeking to grasp a wily phantom, which at every turn appears likely to be secured, but finally "vanishes into thin air." The subject however viewed is abstruse, unyielding, and mysterious, but yet, there are many attractions about it which render its consideration alluring

and irresistable. In the almost total absence of any reliable information on all points our only alternative is to accept some hypo thesis, founded on the researches of some competent authorities. Science is progressive and the opinions of the most able and careful investigators are frequently shown to be founded on error. I have consulted various authorities in vain, and find I have a choice of *probabilities* but can gain no truly reliable informatiou in regard to the development of fungoid diseases in plants. The works I have read express the views of Sir Humphry Davy, Fries-Fee-and Bauer, and other diligent investigators and in forming my hypothesis I shall adopt their suggestions and believe "that the vapourlike spores of fungi float about in the atmos-"phere in countless myriads only waiting for the presence of "a fitting soil on which to alight and grow." Fungi may in fact be classed as Nature's nomadic scavengers and are sure to appear and flourish wherever circumstances favoring their development exist. With regard to Leaf Disease I shall assume it to be a pest allied to the Uridines and shall therefore suggest that it takes its origin in,—or that its development is at least favored by,—a parasitic soil,—that its spores are absorbed by the roots and grow in, the parenchyma of living plants and thus pass through the sap vessels to the leaf.

In my next chapter I shall endeavour to justify the course I have adopted. I am perfectly aware I shall be severely reprimanded for choosing this theory, but I can only say, that until something definite is authoritatively given to science I prefer to be influenced by old fashioned ideas than to accept the contradictory propositions which one constantly sees in the newspapers. "Bauer computes "that two million five hundred and sixty thousand individual "fungi (Uredo fœtida) would be required to cover one square "inch, and Fries has calculated that each of these individual "plants contain upwards of ten million spores, which are as

"subtle as smoke." The experiments made by Fee and Ba- "uer in regard "to minute parasitic fungi" I maintain ap- "ply to Leaf Disease—"having collected some leaves of a "Rosa Centifolia which were entirely covered with Uredo "rubigo, he took three Rose trees of the same species, the "leaves of which showed no trace of Uredo and having put "them in separate boxes, removed them from the neighbour- "hood of the affected plant but still kept them in a similar "aspect. One part of the Rose leaves covered with the Ure- "do was mixed towards the end of the winter with the mould "in the box of one of the Rose trees, and the remainder "subsequently used in the manner immediately to be detail- "ed. When the second Rose tree was in full vigour and near "blossoming, some of the affected leaves were frequently "shaken over the soil to detach the seminules of the fungi, "the remaining portion of which remained attached to the "leaves. The branded Rose leaves were then steeped in "water and the third rose tree watered with the mixture "during the whole of the spring. The three insulated plants "exhibited nothing particular until the autumn: then the "rose tree in whose soil the brand-bearing leaves had been "mixed, became profusely covered with the Uredo, the other "two still remaining free: but the succeeding season the "whole three trees were branded with myriads of Uridines. "The above according to Fee prove "That the seminules of "the fungi are absorbed along with fluid nourishment by the "radical fibres, that those which are mixed with the soil and "become applied to the roots before the opening of the buds "are more readily absorbed and developed, than after the "leaves and flowers have been formed and that the period "in which the fungi burst is often the period of maturition, so "that the wind carries them in clouds from place to place "and the rain precipitates them to the ground. The vici- "dity of these spores when wetted serves to fix them to the "root." What should the Planter learn from this? I main-

tain that it is a great mistake to bury, the affected leaves and that as it makes a whole season's difference in the development of the Fungus, such is worthy of the closest attention. Leaf disease I believe to be a special type of the order Uredinales or Mucedinales (Fries) to which belong a host of Fungi entophyti. The fungus being once propagated only awaits a favorable season when a plentiful supply of œrial spores are absorbed by the roots and passing through the sap vessels pervade the whole cellular structure of the living plant and upon fuller development the fungus effloresces on the leaves and directly interfering with the functions of all the most important organs causes incalculable loss. The resting spore, or as it were, the chrysalis spore, probably remains in the soil and "is the means of carrying on the life of the fungus until the next season" so that once contracted, the Leaf disease must be expected to return each season with greater virulence, unless means are adopted to eliminate it both from the *soil* and from *the plant.*

This class of fungus has been sub-divided into Albugines, Rubigines and Nigredines, according to the different colors, and is noted for great discrimination in its choice of a suitable matrix. Each has particular favorites, in the same manner that the Æcidia attacks the gooseberry and leaves the currant bush alone and the Owygena, a curious fungus which has never been discovered on anything but horses hoofs lying to rot in shady places (Johnson). Rot in Coffee has been known to Mysore Planters for years and was I am informed noticed by Dr. Bidie the Commissioner appointed by the Mysore Government to investigate the circumstances connected with the visitation of the Borer, who is said to have ignored the presence of the fungoid web altogether and ascribed the cause to defective drainage only, and it is argued that the *effect* has been mistaken for the cause. In justice to Dr. Bidie it is necessary to remark that he visited the Coffee Districts to enquire into the facts connected with

the visitation of the Borer which was essentially a consequent on drought and I may be pardoned if I suggest that he saw the *effect* of the Rot only—as he did not I believe visit the estates in a wet season of the year—to make an investigation of a scourge brought on by drought.

Rot (Pellicularia Koleroga) (Cooke) may be classed among the Mucedinœ. It is generated in soils, surcharged with decaying vegetable matter, in faulty mechanical and chemical condition.

What its peculiar requirements or special food are is yet undetermined, but as it has not yet appeared in Ceylon where cultivation is carried on in the open, and is a type "hitherto unknown to science of a well knowing genus" (Cooke,) suffice it for the present to say that it is generated and propagated among forest débris which consists of the droppings of a thousand different trees and that the Coffee tree is of a nature suitable to its requirements. The mycelium threads ascending, probably, from the ground attach themseves to the stem and creeping on, extend over the under surface of the leaves and upon the complete development of this epiphytic fungus a web is formed which assisted by its "gelatinous element" (Cooke) hermetically seals the breathing pores of the leaf and causes it to rot in heavy rain. A careful examination of the soil in the vicinity of trees suffering from Rot shows large quantities of vegetable matter in a semi-decomposed state and completely bound together with fungoid filaments. I strongly recommend a careful and Scientific examination of a sample of this matter and I am confident that such will satisfactorily prove that the fungus is in the soil. Like all other parasites however it lives on the principle of individual responsibility and the smallest portion possible is able to take good care of itself, hence the idea of rubbing the stem to break the communication of the fungus with the soil would be apparently

a doubtful remedy to recommend, and yet, strange to say such has actually been found by me greatly to assist trees to combat with this pest and further, if the operation is extended to the affected branches the effect is very satisfactory. The modus operandi is extremely simple and many a fine healthy shoot may be saved by simply passing the first two fingers somewhat roughly over its lower surface without touching the leaves at all. Such is only a very mild palliative and of course could not be universally adopted, still it is very simple and one who takes an interest even in the mere appearance of some of his best trees will find it very easily performed in the incipent stages when perhaps only a branch here and there is affected. The pellicle of the Rot soon dries up in sunny weather and as Dr. Bidie only makes a cursory remark on the subject, I fancy the presence of the web in its dry state did not attract his attention. I have myself met several Planters who had never noticed the web at all. I have however carefully examined the leaves of coffee trees in places in which I was led to expect the disease to appear. I have daily watched for the first appearance of the foe and have daily noted the stealthy advance made by the mycelium threads over the healthy leaf. By the aid of but an ordinary miscroscope any one can distinguish the web on leaves, which to all outward appearance are healthy and vigorous. A few days is sufficient to effect complete destruction but if the film, even in its advanced stage, be rubbed off with tho finger, the progress of decay is immediately arrested. I have heard many theories relating to the causes of Rot and among them one was that the foliage in the monsoon was too thick; and that the remedy was severe handling. Probably the remedy was good; but the benefit was not derived from free ventilation alone. I believe handling equalizes the distribution of the sap and in a tree too full of new wood there are always many shoots less nourished than

others; their vital energy is not so well maintained and they are certainly the first to be attached by the insidious mildew. The upper branches alone of trees are often attacked while the lower ones are left untouched. Trees in well regulated shade are often unaffected while those in more open spots are completely denuded of their leaves. I think this proves either that the constitution of a coffee tree in well regulated shade, in a country subject to drought, is more vigorous and better able to battle against the foe or that the fungus actually requires a *certain* amount of light, air and water for its development. I am certain that when a tree is either attacked with Leaf disease or Rot that it is consequent on or contemporaneous with, a state of defective vital energy. Who can tell how many trees have had just a touch of Borer? How many are in poor, stony or clayey soil and have suffered from drought? Who can tell the impediments to the ready flow and equal distribution of sap consequent on contraction of cellular tissue, and the effects of years of bad and heavy pruning. If we think for a moment we can easily imagine that a few sunny days after planting may shrivel up some sap vessel or other part of the plants interior structure which may never be serviceable again. A check in fact may be sustained in many ways and although in after years the tree may be healthy and vigorous in other respects, it still may be more susceptible to diseases which a plant of a more robust constitution would be able to ward off.

Add to this, a want of a special element of plant food and the fact that during heavy rain, and on a soil in bad mechanical condition, that all growth of weeds and trees ceases when a complete state of saturation exists—can we wonder that parasites get the mastery over the tree. In my opinion Dr. Bidie is quite right about the cause and as I before mentioned, he only took a cursory view of the subject,—I hope I may be permitted to show that drainage

actually by removing the natural food of fungi and keeping up a constant supply of plant food is the operation *par excellence* for mitigating the ravages of fungoid pests. I am convinced that the causes which induce Leaf Disease and Rot in Coffee are identical in at least some respects.

I am of opinion that the development of fungi is favored by certain abnormal peculiarities of a naturally parasitic soil, consequent on faulty mechanical and chemical conditions and a diminution of its solvent properties, caused by the exhaustion of special elements;—these have the effect of prolonging at certain seasons of the year peculiar phases in the process of decomposition of organic remains which eminently favor the development of fungi generally. Exception I am aware may be taken as the necessity for draining as Leaf Disease generally appears in the most virulent form on exposed hill tops and faces. As I have before mentioned, land which has been long exposed and *superficially* worked, gets into a *cold* and plastic state and as all the finer particles from a hill top have long since been washed away, I am strongly of opinion that such sites are more in need of deep working than any other. Surface drainage, actually makes soil richer, and its influence on hygrometric properties is unquestionable. As rain water is the vehicle in which plants food is dissolved and rendered available it stands to reason the fresher the supply the better the plant is nourished. A soil out of condition, however, often greedily absorbs water, but once saturated, it remains so, until the water is actually evaporated by the sun. What the cultivated plant requires is a firm, porous soil, well mixed, and sweet, and such alone can be obtained by systematic attention to digging and draining at the proper seasons of the year.

Draining the surface has in my experience had the effect of making Leaf Disease run through its phases *more* rapidly—probably by removing the food for the fungus and

converting it into food for the higher order of plant. I can positively assert that the effect is marvellous.

Last season I carried out the operation extensively with the result that the disease did not last 15 days, whereas in places not thus attended to, the disease continued until every leaf was destroyed. As before remarked I am confident that there is a period during the monsoon of about 15 days when all growth of weeds and trees actually ceases and I maintain this is caused by complete saturation of the soil. This is one of the particular conditions we want to make our arrangements to prevent, it being undoubtedly contemporaneous with the period when the fungi are springing into activity. A few days sun developes the enemy, which once formed must inevitably pass through its various phases.

I strongly advocate the use of Lime and Wood ash coupled with pickaxing and surface drainage. I suggest that all digging and mixing of the soil in wet weather be entirely discontinued; such tending to increase plasticity, and the liability to remain in a sodden state, during the rains. Digging should be always considered essentially a fine weather operation. If weeds and debris are abundant, such should on no account be buried deeply but should be allowed to decay in heaps on the surface, or in renovation pits and be utilized subsequently as manure. "*Scraping* and burying in" is a most objectionable process and should be discontinued. The "turning in" of weeds is a very different operation and one much to be recommended, being adopted by Gardeners in England and elsewhere. It consists of digging the surface to the extent of a few inches, each spadeful being completely upset thus the weeds are superficially buried and the soil improved. The old system consisted of scraping all weeds and debris into a deep trench which was then covered up and the surplus soil from the pit scattered

over the surface. No good can possibly result from such an operation. The weeds thus deeply buried pass through a tedious process of fermentation, but ultimate decomposition is seriously retarded. A mass of fermenting rubbish must give off most noxious exhalations and the soil must be soured instead of sweetened. The continued burial of surface debris in this way robs the upper layer of soil of all the valuable organic elements of plant food and the feeder roots are unable to support the plant in vigor. The operation moreover seriously affects the physical condition of the soil, which gradually becomes compact, retentive and unmanageable. The land rapidly loses its hygrometric properties, and during the monsoon becomes quickly sodden or saturated. I have recently had the pleasure of reading a most valuable essay, by Major A. F. Corbett, B. S. C., among a series of professional papers on Indian Engineering, edited by Major Lang, R. C., Principal of the Thomason College—Roorkee. Some of his remarks accuratly apply to Coffee cultivation and demand the most earnest attention. I shall make a few casual extracts, in each of which there will be found ground work for mature consideration.

"Clay soils which can be rubbed into an almost impalpable powder have a much less power of capillary attraction than gritty sandy soils, but whilst clay or loamy soils have less power of capillary attraction they have a greater *retentive* power for moisture; that is they will retain moisture longer when once it has penetrated into them and will not lose it by evaporation or filtration."

"The roots of plants require air as well as water but the air can hardly penetrate the now almost hermetically sealed surface soil."

"The more water supplied by irrigation the more parched the land becomes when the crops are removed and irrigation ceases."

"Solar heat is *reflected* from the hardened surface."

"Irrigation applies water to the surface—crops do not want water *on* the land but *in* it."

"Rain water will pass through loosened soil by gravitation, leaving the soil moist, and as the upper surface is dried by evaporation caused by the heat of the sun, the water lost by evaporation will be replaced by water rising in the loosened land by capillary attraction."

"Liebeg says. The *outermost* crust of the earth is destined for the *development* of organic life and its *broken* particles are endowed by the wisest arrangement with the power of collecting all the elements of food which are essential for the purpose."

"I look on capillary attraction in solis as the power the soils possess of containing moisture in the *interstices between* their minute particles and I consider the retentive power of soils to be the power which they possess of retaining moisture *in* their very particles."

Captain C. S, Thomason, R. E., in his essay dated Agra, 13th December 1871, says—

"The more water that can be passed through the soil the better so long as it does not remain *in* it."

"Subsoil drainage combined with deep culture enables land to withstand drought."

"If an (impervious) pan underlies soil how can water pass through."

"Deep cultivation will avert a considerable amount of heat *radiated* from the earth."

From a persual of the above quotations I gather that the culture and manipulation of our soil is indeed a subject for mature consideration. How can we expect success by superficial cultivation ? To maintain a plant in vigor we must at least work our soil and assist Nature to help us.

The subject is one of vital importance and in concluding my remarks on parasitic disease I fearlessly assert that all remedies must go into, and affect, the SOIL, which alone gives energy to the plant which by Nature is constituted the medium for elaborating its hidden wealth for the benefit and use of mankind generally.

CHAPTER 3.

JUSTIFICATION FOR REMARKS ALREADY MADE, AND FINAL CONCLUSIONS.

I wrote the substance of the two preceding chapters in the year 1876, some of my remarks having been printed in pamphlet form and the remainder having appeared in the Madras Athenæum and Daily News, to the Editor of which I am deeply indebted for his many kindnesses in regard to the subject. I have patiently waited in the vain hope that some scientific person would come to our rescue, but what has been the result? In a recent number of the Ceylon Observer, I find that a sort of retrograde movement is all that has to be chronicled, and that after nearly eight years investigation some of the leading *"Scientists"* have been CHARGED with entertaining the idea that Hemileia Vastatrix "was in the very blood of the plant, the germs permeating and flowing with its life juices." Further on we are told "the eye observations of practical planters as well as the miscro-"scopic researches of more scientific observers unite in the "conclusion that the affection is purely external."

Now Mr. Cooke in his report gave me credit for distintinguishing the difference between Leaf Disease and the Rot, the former being as I remarked a fungoid *efflorescence* and the latter a fungoid *deposit*. He further stated that the "Hemileia was a veritable endophyte developing in the tis-"sues of the leaf, expanding outwards, as is the case with the "*red rust* of corns and grasses." Now let us consider what an Endophyte is. On turning up for information in my old Book on Botany—the author of which I regret I am unable to name, owing to the title page having been lost, I find "that three *types Uredinaceæ*, the *Nemasporaceæ* and the "*Sporodismiaceæ* collectively form the *section* Uridinœ, the "first or lowest of the *order Uredinales* or *Mucedinales.* By Fries they have been called "Fungi Entophyti" and the

"chief diagnostic signs will be found to be, that the spo-"ridia are either wholly uncovered and seated on the surface "of the leaves of the plants on which they grow, or that "they quickly become so, by bursting through the cu-"ticle, by which at first they were concealed. Hence from "this *one portion* of the *group* the common name "Ento-"phytes" was derived which however, although, rightly "descriptive of a part is not truly applicable to the whole." In fact when we come to deal with a *type* of a *Section* of an *order,* classed as a *group* it must be allowed that a mycologist has no easy matter before him first to endeavour to determine accurately a proper and systematic location of the genera, and then to assign to each individual specimen belonging to such a complicated order, a sufficiently exact appellation or cognomen to satisfy all critics. In fact in Botany one of the fundamental principles in the name-giving department is to endeavour to fix, upon a compound term derived from the Greek, Latin or *Sanscrit* languages as will in the smallest possible space give expression to the principal distinguishing characteristics of the individual plant and its genus, or family. I maintain that Mr. Cooke has conducted his investigation under peculiarly favourable circumstances, in having been supplied with abnormally fully developed specimens from Mysore, where coffee is cultivated under shade, and deserves the greatest credit for his matured opinion thereon.

His observations as to sporidia of the Hemileia in my humble opinion, leave not the ghost of a doubt as to the class to which the fungus belongs.

To the uninitiated like myself, section 511 of my old-Botanical Book is at least somewhat startling to the nerves of one, anxious for practical information, but it affects the case, so fearing to trust myself single handed among so many confusing technicalities, I again make another quo-

tation. "The sections Uridinœ, Mucedinœ, Mucorinœ, and "Tubercularinœ form when associated the order Mucedina-"les. The naked sporidia either always destitute of covering or "quickly becoming denuded with the destitution of true peri-"dium perithecium and hymenium organs present in the other "orders, form the characters which associate these sections "into a common group or order, and distinguish them from "all other fungi." Such information to an ordinary practical man is somewhat tantalizing, but it is of use to show us that Mycologists have enough to do before they can even *identify* the type of a fungus and give it a properly and scientifically assigned place in their note books. I am therefore strongly of opinion that we should leave the "scientists" to work their own oracle in a quiet methodical way and that the planters should take a middle course and leave all technical difficulties alone to be dealt with by those who have made such the study of their lives. I feel personally that I have run a very great chance of incurring condign censure for merely approaching some of the intricacies and entangled ramifications of the subject when considered from a theoretical and technical point of view, but as I have only done so to form an incentive for skilled investigation by my betters I feel that all I have said, far from detracting from the powers the scientific world, most assuredly redounds to the glory of its representatives. An Endophyte therefore may be said to be a parasite developing in another plant, penetrating its substance, and feeding upon, its juices. As before quoted Fries, Fee and Bauer all considered that the spores entered by the roots and pervaded the cellular tissue. Mr. Worthington Smith has clearly proved that the Peronospera Infestans is also a veritable Endophyte and has found "that the Resting spores which carry on the winter "life of the Fungus are not confined to the leaves, but are "found sparingly in both haulm and tuber" (*Appendix*) Now if the *resting-spores* of one Endophyte are to be found

in the whole structure of a potato plant, the other processes of the fungus must be present also in an even more diffused form, and I fail to see why it is unreasonable to presume that the same is the case with Hemileia. I shall attach Mr. Worthington Smith's remarkably lucid report to these "Jottings" as well as an article from the "Gardeners Chronicle" and hope I may be forgiven for the liberty I have taken.

I am aware that Mr. Smith does not say anything about the disease entering by the root—and that I may be told that the fungus having attacked the leaves gradually developed and extended to the tuber. My reply must be that if leaf, haulm and tuber are liable to attack, and if the resting spore remains in decayed portions of such in the soil, that when a new crop is planted in the same field that the roots as well as the other portions of such a plant would be liable to attack also, and that if the pores of the leaf are large enough to allow the entry of spores, that there is every probability of the roots taking them up with even greater facility. If the juices of a Coffee leaf are congenial to the life, energy and requirements of the Hemileia, why should we not think that the fungus probably extends its operations beyond the leaf into the more juicy structures in the body of the tree. Mr. Smith says pointedly—that even in the leaves it is extremely difficult to see such spores even with a microscope and that to get them out is no easy matter as they closely resemble the leaf-cells which are much of the same color, and are almost as hard as wood. In Sir Joseph Hooker's report printed in the Planter's Gazette of July 31—1877, he remarks " Mr. Berkeley's examination of " the Hemileia was made from *dried* coffee leaves transmit- " ted to this country. A first essential is a more adequate " study of the fungus than such specimens could afford, " especially in all details of its life history from germina-

"tion to functification." I do not know if all observers have seen the Hemileia on the green Cherry. This season I have seen such frequently—the whole cluster being covered with the efflorescence. In the shade also, the fallen leaves all become perfectly *white* with the fuller development of the Fungus and this I suggest should be considered in connection with Mr. Worthington Smith's remarks about Zoospores and robust health of the fungus.

I have no scientific reputation to lose, and even if I had, I cannot see how I can be blamed for the theory I have adopted after careful perusal of the opinions entertained by scientific investigators in regard to the habits of endophytes of a kindred nature. I have now given my reasons, my authorities, and my justification for the remarks already made and even allowing that through ignorance I have misunderstood all the bearings of the subject I maintain still, that to a coffee planter who grows and cultivates a perennial, which lasts for many years—it matters little where the germs of a disease or Fungoid parasite enter or originate and that the best thing where a remedy is unknown, is to support the strength and give the plant a chance of withstanding the fury of the attack. We may in many ways modify the constitutional tendency to disease, even if we cannot cure it. It may appear absurd to talk of a parasitic disease being *hereditary*, but who will doubt that certain peculiarities of constitution may be inherited which although not actually capable of producing the disease may yet have a decidedly predisposing effect? A planter's policy must be a decidedly vigorous one "Masterly inactivity" means certain ruin and everything must be done and maintained by the habitual use of experience and prudence. Experience is a progressive accummulation of knowledge derived from trials, use, practice and observation and as such must be our only guide. With every apology for the analogy I would say I wish what I have written to be the red handkerchief

held up to hasten a conflict and while issues are being tried the grateful Planter will gladly avail himself of the progressive development of hints and suggestions evolved by this desirable process. We have alone to deal with stern realities and a few dry facts founded on practical experience and well conducted field experiments will help us much to mitigate the evil we vainly hope to conquer. Let each member of the Planting Community conduct experiments. Let various manures be tried in different places and let careful notes of results be recorded. Let each work out his pet idea. Let mechanical operations be tried—such as drainage (surface and deep)—pickaxing—versus mammotying—Hand weeding versus Scraping—Manuring the surface against manure buried iu trenches—Bones versus Poonac—cattle manure—versus compost of vegetable matter, pulp, husk, and wood ashes, and last but not least experiment with seed from various distant places, and let all Planters opening in a new District try a "steep" for their seed—say a lime and water or blue stone and water. Mark the effect of digging in dry weather and compare such with a similar operation performed in the rains. Closely attend to the sad influence of Leaf Disease on "heavily" pruned Coffee. Examine studiously the effect of the Fungus on well matured shoots as compared with the wholesale havoc in badly handled coffee. View and ascertain facts, relative to the proportion or ratio of loss in the Chickmuglore, Coorg, Ceylon and Rio varieties. These I maintain are a few individual points for practical observation. Let the Planter arrange *these* as types, orders, genera and groups, and I fancy he will do himself a vast amount of good in the process. Let, I say, each Association in Ceylon and Southern India afford assistance in the collection of such facts and information and I feel assured that there will be no occasion for regret hereafter. In a criticism on my unassuming production I have been told "to adopt a humbler strain and

lock away my Agricultural Chemistry, my Liebeg and my Botany Book." I have long since done so, but I have vainly waited for my betters to instruct me as to causes, development &c. and hàve even to regret that practical Brother Planters are loath to record the effects of experiment. There seems a confirmed dread of what is called "rushing into print" and alas! too many remember the old saying, "Oh! that my enemy would write a book." The world is only an extended system of Brotherhood and if every body is to fear the remarks of his neighbours the sooner we all become Hermits the better. Let those who work for the common good remember that jealousy is generally at the bottom of rude criticism. A professor of an art naturally wishes to maintain his dearly bought rights, but does not resent unskilled interference and like the honest British workman and his money—is always generously inclined and will frequently give up gratuitously the benefits derivable from his researches.

Look for example to the case of the inventor of the Microphone. An invention which will extend almost supernatural powers to man, has been gratuitously presented to science. I ask again how many Planters have read of the discoveries and researches of Mr. Worthington Smith? As a fungologist of great eminence science is indebted to him for his elucidation of the wonderful process of hibernation of the Resting or chrysalis spore of the Endophyte which constitutes the Potato Disease (Peronospora Infestans.)

For years this Fungus had been under investigation and doubtless much useless attention had been given to what casually appeared to be Epiphytic in its nature, but it was reserved for Mr. Worthington Smith to demonstrate that such was merely a superficial appearance connected with the incipient stages of the disease a fact which he proved beyond a doubt by actually developing artificially by the

means of wetted calico the veritable Endophyte and further in the process discovered the habits and circumstances connected with the Winter life of the Fungus. At this stage I would ask—has Mr. Worthington Smith's assistance been enlisted in our case? I am afraid not; but I can only say that from the generous and public spirited way in which he gave his discovery to science I have no doubt that he may yet be induced to throw his skill and unbounded talents into the scale against Hemileia Vastatrix.

In conclusion I would strongly recommend those whose Estates regularly suffer annually from Leaf Disease and Rot to adopt the following measures until an infallible remedy is found out. Let the Estates be carefully pruned, lightly but efficiently removing as much lank and useless wood as possible but always endeavouring to keep enough leaf and wood to "carry the sap." Let handling follow and be judiciously maintained through at least four operations. Manure by spreading on the surface so as to stimulate and rapidly assist the trees through their feeders—the small capillary roots—where manure is scarce, spread all debris and vegetable deposit evenly over the surface and break up all rotten trees, stumps &c.; keep the land clean by periodical hand weeding and be very careful not to allow *grass* of any sort to appear, or at least remain. As early as possible after the advent of rain—and taking advantage of sunny weather use the Pickaxe freely and deeply, and leave off digging when the heavy rain commences. Let digging only be performed on fine days. If time and opportunity permit —endeavour to surface drain as much as possible. Let lime, wood, ash and bone dust be always mixed with all manures. Discontinue the most objectionable process of "*scraping* and burying in"—such robs the surface of all valuable deposits and places them out of the reach of the "feeder" roots and moreover makes the ground smooth and

hard. Let the handling gang rub the stems well and remove all moss and scales, and during the prevalence of disease, endeavour to assist the trees by removing with the knife from time to time any shoots or wood which may be injured by Leaf Disease or Rot, beyond the hope of recovery. This operation coupled with the system of "breaking back" to healthy wood does more to keep the tree in condition than is usually supposed. If an Estate is treated in this way, Leaf Disease, even if it does appear, will do comparatively little injury, and with favourable weather will not last nearly as long, and consequently the trees will have less to stand and longer time to recover. Where such operations as I have suggested have not been performed and the Leaf Disease has made it appearance, I unhesitatingly assert that pickaxing deeply is about the best operations to adopt, and I may remark is one also which can be done quickly and consequently can be carried out when other operations are impossible. A very large percentage of leaves affected with disease, may be easily collected and put into the open renovation pits where they may with advantage be dusted over with the following mixture :—

100 parts Lime
100 ,, Wood Ash
5 ,, Flowers of Sulphur.

CHAPTER 4.

GENERAL REMARKS.

To enable man to continue to produce a crop containing Lime, Potash, and Phosphoric acid in very large proportions it is absolutely necessary that the soil must be at least carefully *"worked"* seeing that Coffee is not a crop which is indirectly returned to the soil but is absolutely grown for exportation. This matter is too frequently lost sight of and urgently calls for attention, many so-called cultivators not even carrying out the most ordinary operations calculated and known to assist Nature to perform thoroughly the mysterious, yet, necessary, transformations which are always going on in the soil. Leaving manuring out of the question there are many mechanical operations which unless properly carried out, the Planter cannot even hope to obtain more than a fractional portion of the hidden wealth in even the best of soils. A good worker with an ordinary or even inferior soil may expect to obtain relatively greater results than those who are content to trust to Nature doing all for them. How often is the man who adopts a novelty in cultivation laughed at ? Is it not a usual habit with some men to ridicule any innovation ? It can be unhesitatingly allowed however that many a man has had the desire but failed to secure the opportunity simply by having worked in the wrong direction, yet undoubtedly one of the principal causes of failure may be recognized in the fact that few planters in former days were fond of either giving or receiving advice. Each apparently was digging for some secret treasure and anxious to obtain it first, and consequently the energies of many were expended uselessly. Not a single book containing anything more than the mere rudiments of planting was available. Failure was the inevitable result and with it came many lasting benefits. Nothing now is commenced without care and enquiry.

Disaster has at least given *experience* and now perhaps it would not be too great a compliment to pay the planting community to say that amongst its numbers there is no lack of thinking men well grounded in experience and duly alive to the necessity of trusting to such rather than to mere chance. Suggestions and hints are now freely exchanged and no one need fear a rebuff provided his experience has been somewhat of an extended nature. A lively interest is taken now in the result of experiments and many a fortunate Planter owes his prosperity to having carefully watched the failures, experiments and successes of his Brother cultivators. Many a man of five or six years experience can now successfully compete with the older hands—but still all are ready to gain information and it is generally allowed that the older the planter gets the more he finds he has yet to learn.

It is not however for the "old hands" that this little manual is particularly intended, it is more for the younger men who have recently ar rived and have thrown their lot in with our own. As I before remarked a Planter of 5 or 6 years experience may in many things successfully compete with those who have been three times, as long in the country, but I maintain there are few who would not readily admit that although for "*new work*" they fear nothing, still that in the matter of working up "Old" Estates there are numerous things concerning which information would be gladly accepted. A young Planter likes to be in possession of information which will suggest rather than direct, and I trust that in the following pages that it may be rendered apparent that there are many things which even in skilful hands may be done wrong, unless the person superintending them has had previous personal experience. I will make no further apology to the "old hands" than to say that I am well aware that cultivation elsewhere is far superior to what is carried on in this Province and I willingly allow

that Mysore would be the last place in the world from which advice would be sought. However the Chapters on Leaf Disease and Rot may afford some interest to those who may have suffered from these pests, and I doubt that few will be sorry to find that their younger Superintendents and Assistants are in possession of a few more hints and suggesions than perhaps their time and convenience would have enabled them personally to give hem. Within the last decade cultivation has wonderfully improved and failure has rather been the exception than the rule; but as I said before the new comers will hardly be able to say that they have not profited by the failure of their predecessors and to enable those who like to commence where others left off a return to consider even the very rudiments of the profession will not be found sometimes out of place. Dr, Lynn's favorite expression "that is how it is done" very often crops up mentally rather in the form of an interrogation when men treading the same well beaten track come to obstacles already met and surmounted by those who have gone before them. It is an old and very true saying that it is easier "to build a new house than to alter and improve an old one." Such is also truly the case with Estates. Once an Estate begins to call for a "helping hand" the Planter finds out how very little he can do to assist in comparison with what Nature had hitherto done in the matter of maintaining success. To clear—to line, hole, plant, and weed, an Estate always appear difficult operations to the novice and he is often inclined to accord himself great credit for the many difficulties surmounted. The young coffee grows, is topped and field after field closes in a fine sea of young coffee. Now the troubles commence—leisure becomes restricted, management actually usurps the place of Superintendence and the Planter finds he has made for himself a very hard and exacting master. Each day a new operation is called for, fresh energy is constantly demanded and advice

has to be sought to meet requirements. One often hears a young man, say, " wait until my place is all planted up and then I shall have lots of time to amuse myself." What is the experience of those who have tried the experiment? I maintain that a great deal of the future prosperity of an Estate absolutely rests on the treatment that it receives after the first full crop. This is the turning point at which to watch and assist the young hand, but how few deem assistance necessary and how many a flourishing property has been almost entirely ruined by want of experience at the critical moment? How many an Estate has been literally hacked to pieces under the so-called operation of pruning?

About this period all errors, faults and omissions "show up." One place has been too much opened up—another too much sheltered. Here the plants have been topped too high, and there perhaps too low. The rainfall is probably found to be less than was expected growth,—is found either more or less luxuriant than was arranged for and the trees are consequently found to be either too close or too far apart. Shelter in one place has to be arranged for and shade is found indispensible in another. Such and a hundred other things come somewhat hard on the young hand and require of course to be met with caution, judgment and energy. Many estates have passed through this trying time without skilled supervision and the result has been that such have been either permanently injured or absolutely ruined. Much attention has often been transferred to extension and the making of new clearings when such should have been directed to the trees already established and in this way I may almost certainly say that nearly every Planter has a thorn in his side somewhere.

I feel assured therefore that should I attempt to endeavour to touch on subjects connected with the formation of an Estate I should, most certainly fail ignominiously, seeing

the vast amount of experience that is available in every planting district, and the number of able men who are better fitted for the task, but I venture to think that there are many who will agree with me in saying that where difficulties have actually arisen through misadventure or other circumstances, there is no harm in endeavouring to make a few practical suggestions towards assisting in making the best of a bad job. I shall therefore confine my remarks to the management of old estates such as are generally to be met with in Mysore, where owing to a dry climate, low altitude and variable rainfall, cultivation is carried on under shade, where many mistakes have been made and subsequently rectified and where a planter's experience is not only dearly bought but is also of a varied and composite nature, and where it has been the business of Managers and Proprietors for the last ten years to undo or at least counteract the mistakes and misconceptions of former days and endeavour to make the best of estates which were opened in ignorance, worked with progressive experience, and now in their maturity give their owners lots to do and plenty to think of. In regard to soil I consider it would be vain to attempt to do anything more than generally point out what should be considered as typical, and leave the rest to individual judgment and discretion. One cannot always get what is wanted—perfection—but with typical requirements and conditions given, a man of ordinary intelligence can generally be trusted to form his own conclusions more satisfactorily than by being led by more definite directions.

CHAPTER 5.

SOIL.

Although it would be impossible to lay down any fixed rule to euable a person to judge definitely as to the suitability of a given soil without subjecting the same to both Chemical and Mechanical analysis still for ordinary purposes a fair estimate of any soil may be made by attention to certain observations as to condition, texture and appearance at the same time being careful to ascertain its origin, depth, and foundation. Technically speaking, however the hygrometric properties of soils, materially influence their fertility in practical cultivation, and such properties may again be modified or intensified by Aspect, Elevation, degree of Solar exposure and Mechanical operations; facts which as materially affecting the welfare of the enterprise should always command the most careful attention.

The coffee-planter's beau-ideal of a good soil is a deep, moderately firm admixture of loam and Silicious particles of disintegrated rocks containing the chemical elements of plant food necessary for maintaining the Coffee plant in health and vigor. The principal elements necessary are Lime, Potash, Soda and Phosphoric Acid, but it is vain to hope for success by merely ascertaining the presence of these necessaries as the fertility of a soil alone depends on the peculiar *state* or *condition* in which they are present. Quantity must be to a certain extent sacrificed for quality in judging of the value of the various constituents contained in a given soil and primary attention must be given to the state of combination in which they are found. The greatest difference exists between soils formed by the decomposition or disentegration of various rocks and thus we are greatly assisted by knowing that the soils resulting from Limestone are physically poor and ill-bodied; those from Sand stone

are porous and friable; and those from Slate are cold and heavy; while the purest clay is produced by the decomposition of Felspar.

Now it must be self-evident that a mixture of constituents will produce a result in accordance with the proportion in which such constituents exist; and consequently by substituting practice for theory, to enable us to ascertain what class of rock to look for, we should first decide as to the texture and properties of the soil required; or *vice versa* we may examine the description of rock that abounds and form our conclusions upon it. Gneiss is the class of rock generally found, and it is known by its banded structure. It contains Mica, Quartz and Felspar and being assisted by a climate famous for violent alternations of temperature and a heavy rainfall, is generally found to be in a state of far-advanced decomposition, and consequently may generally be relied on as a good producer of lime and potash. The soil formed from this rock by Nature is a mixture eminently suited for the Coffee Planter's requirements, and merely requires to be adequately tempered with organic constituents to offer every prospect of success to the *practical* cultivator. For a casual examiner however all observations and tests must be simplified as much as possible, and of course coffee like every other enterprize must take its chance. If reliable data were available there would never be failure, but such is not the case and the Planter has to take his chance, very often relying entirely on appearances in selection of the land. For greater safety it is desirable to use discrimination, care, and forethought founded on experience, on the principle of the old proverb "Look well before you leap" and it behoves one to study the appearance and texture of the soil as well as to ascertain its actual origin and extent. The best descriptions of soil for coffee are decidedly the dark chocolate and black.

Very bright red soil is to be generally *avoided* unless actually *proved* good by experiment, and although white soils are generally poor and unreliable some have been known to produce and maintain excellent coffee. Medium in all things is desirable. A coffee soil should be of good average depth, and the subsoil should be separated by a mere imaginary line; all violent or sudden changes in appearance and structure being bad. A Planter unlike a surface cultivator looks upon his subsoil as a reserve fund to be utilized as required, besides being the source of nourishment during the hot weather, when the top-root almost entirely supports the plant. The physical condition of all sub-strata exerts a marked influence on the surface more especially in soils highly charged with organic constituents. Stagnant water produces root fungi which are deadly enemies to all tap-rooted plants and nearly all injurious Chemical compounds have their origin in the presence of surplus and sour water which prevents the exit and entry of the various gases. The surface should have a rich deposit of decomposed vegetable debris, and its sustaining properties should be judged of by the luxuriance of the general vegetation it supports.

Large trees being subsoil feeders frequently exist in situations where the surface soil is poor and indifferent, but a reliable forecast as to the fertility of the surface soil may be made by noticing the class of the undergrowth. The presence of rank grasses is ominous, whereas a rich succulent undergrowth of coffee weed (ಗುರಕಲ್) mixed sparsely with some description of cane (ಶಾಲಬೆತ್ತ) and Bamboo, surmounted by a dense covering of evergreen forest trees of average dimensions, may safely be considered to be reliable indications of a first class coffee producing soil; provided always that it exists in a position and under circumstances alike favorable to the welfare of the plant. A good coffee soil should be granular—yet firm—that is

when moderately moistened should not become plastic. In a fairly damp condition a mass of good Virgin soil will *crumble* in the hand upon pressure being applied and even after having been wetted will still manifest a tendency to retain its granular form. The *structure* of a sample will evince *visible* porosity. The particles should be *aggregated* but not *conglutinated* together. There is a vast difference between suitable coherence, which is necessary, and persistent viscosity, which is pernicious, and with a very little practice one can easily discriminate between them.

Silica gives friability, and alumina tenacity, while the organic particles temper, as it were, the whole. Professor Anderson of Glasgow says at page 133 of his instructive work on Agricultural Chemistry—"Humus is a substance "of the very highest importance for it confers on the soil "in a high degree the power of absorbing and retaining water, "diminishes its tenacity and permits its being more easily "worked, adds to its hygrometric power and property of "absorbing Oxygen from the air, and by its dark color causes "the more rapid absorption of heat from the Sun's rays. "But it is important to observe that it must not be present "in too large a quantity, for an excess does away with all "the good effects of a smaller supply and produces soils "notorious for their infertility." Further on the same eminent authority says—"For ordinary purposes it might "be sufficient to determine the specific gravity of the soil "in the dry and moist state—the power of imbibing and "retaining water—its hygrometric power—its tenacity and "its color." A planter's requirements demand that the soil be moderately compact—porous, and rich—should be of a dark color—should not become saturated with a moderate amount of rain—and should not shrink in the process of drying. Such a soil offers every advantage to the practical cultivator, will always be warm and sweet and will with a minimum of mechanical manipulation retain an adequate

supply of moisture, but at the same time will permit the requisite amount of atmospheric permeation and not preclude the exit of the noxious combinations which are always being developed in a soil under cultivation.

A firm yet moderately porous sub soil consisting of loam will add much to the sustaining capabilities of most soils, as such retains and holds available any manurial particles which may descend from the surface and will while retaining an adequate supply of moisture afford a free exit to all surplus water. Too much porosity is however nearly as bad as too great retentiveness. It is well to remember that although water is not the only agent which prepares plant food for assimilation, still that absorption of substances is greatly facilitated by its presence. The supply must be proportionate to requirements however, hence the value of mechanical operations to assist in regulating its retention, distribution, or discharge. The presence of sheet-rock or impervious clay in immediate proximity to a rich soil would almost entirely destroy all prospect of success. An intermediate substrata of a porous formation would however go far towards improving matters although not to be recommended or depended upon.

A Northern face affords every advantage to a good soil, and is universally recommended. A Southern exposure is the hottest. An Eastern slope is subject to violent alternations of temperature,—while a Western lay with judicious protection from the monsoon is often highly successful. North West is the best medium for all purposes. For all general purposes therefore a Planter will have to depend on appearances a good deal in choosing land and must judge of the probable sustaining properties by quality and quantity of the vegetation that it supports. An intelligent observer may also examine the class of Rock that abounds in the vicinity and may form his own ideas

as to probabilities; but the technical difference between Labradorite and Orthoclase felspar, is far too deep a subject for anyone unskilled in Chemistry and Geology to attempt, yet an analysis of their composition shows the great value of a slight knowledge in that direction, the former being rich in Lime and the latter in Potash; but here again fortunately in this country disintegration is far more rapid than in more temperate countries and as the Planter mostly has to deal with virgin soil containing the accumulated organic and inorganic remains of centuries, he may generally hope for success by merely using ordinary care in selection, provided always, that the extent, foundation, and general appearance of the soil receive his careful attention, and that the land is situated in a locality otherwise favorable for the cultivation of coffee. The available supply of Phosphoric Acid in most jungle soils of good quality is generally sufficient for several crops but immediately any diminution in vigor or yield is noticed it should be a matter of paramount importance to endeavour by scientific examination to determine whether the store or supply is equal to the demand. The rapid exhaustion of this important element is unhappily often neglected until the plantation has suffered a severe check. It is also a problem for science to solve whether the supply of Sulphuric Acid being diminished has anything to do with the annual increase of fungoid diseases. We always hear of Sulphur as a remedy for the parasites affecting the Vine and the Hop, and I maintain that although Coffee Planters could not be expected actually to supply everything that may be indicated as necessary to maintain their trees in vigor, still that should not prevent them using as *remedial* agents, certain elements of plant food when such are proved by careful analysis to be deficient in the soil. The greatest aim should be to assist Nature. The cultivation of a special class of tree bearing a crop, which is entirely removed from the soil is diametrically opposed to all known principles of Nature's

economy, and sooner or later the onus of maintaining the necessary equilibrium devolves upon those who attempt it. A careful observer of results and appearances may frequently make a shrewd guess as to causes, and it behoves all those who have old Estates from time to time, by experience, judgment and forethought to endeavour in every way in their power to obviate the inevitable results which the uninterrupted cultivation of a special crop is calculated to induce.

CHAPTER 6.

Nurseries.—*Their formation and treatment, with casual remarks on class of tree—change of seed—acclimatization.*

Much of the future welfare of an Estate depends on having a really healthy supply of vigorous plants in the Nurseries. In former years no attention whatever was paid to this important subject and Planters contented themselves with, either jungle plants, or made Nurseries of the "two leaf" seedlings always to be found in profusion under the old coffee. Such plants in virgin soil came on and gave great satisfaction and no one seemed to entertain any prejudice against them until the Estates required vacancies to be supplied after the land had been well cropped with coffee. I shall be within the mark considerably if I state that plants sufficient to have planted the whole of the forest land in Mysore have been planted in vain in the few planting Talooks within the last 15 years. Some conception of the loss under this head may be realized when it is known that one proprietor has accounts to show that over a million Nursery plants have passed out of his Nurseries during the period extending between 1865 and 1873, in the vain endeavour to plant up the *vacancies* in an Estate of a little over 450 acres. Year after year holes were cleaned out and manured, and yet the plants steadily refused to grow. In the latter year a Mysore Planter of experience visited Coorg and came back with glowing accounts of the bearing capabilities and suitable character of the Coorg variety of plant. Seed was procured, and Nurseries made on all sorts of systems, and yet nearly every plant that was properly established in the Mysore Plantations has succeeded and now quite a new Era for the Mysore Planter has commenced. The reclamation of Estates that had been virtually abandon-

ed has since been attempted and whenever sufficient time has been allowed for raising suitable shade, year after year fine fields of vigorous and promising coffee are beginning to take the place of the old shuck and useless representatives of the Chickmuglore variety. Cultivation in Mysore has thus received a decided impetus and although much has yet to be learnt, it is certain that the formation of good Nurseries is one of the first steps towards success. The "Chick" as known in Mysore is still used for *new* clearings and Mysore can still boast of many superb old Estates with coffee still in the height of vigor and perfection and yet over 20 years old. Besides the countless small holdings of the Natives which require to be entirely re-planted; in all large Estates there are always places which do not prosper as well as could be desired. Many a fine Estate was decimated by the dire scourge the Borer. Many a planter adopted the "open system" and cleared away the forest shade, and now many indeed are the unavailing regrets. Those who adopted the crude form of planting like the Natives under dense shade are alone to be envied. Year by year as experience dictated a certain amount of shade was removed, and now after many experiments and much careful enquiry a system of partial shade has been pronounced to be the only one suited to the climatic requirements of this Province. Hundreds of Estates have yet to be planted up anew,

Many require shade to be raised ere there can even be a hope of success, as it would be a fruitless undertaking to attempt to plant even the hardiest variety of plant in land which has been exposed to full rays of the sun, well washed in the rains, and otherwise deteriorated by having been felled many years ago. I shall endeavour to deal with "shade and its culture and management" hereafter but shall now deal with the subject of Nurseries, and in order fully to consider all points of importance, perhaps it will be as well to carry my reader from the very commencement of

the work to which I unquestionably attach so much importance. I shall commence by offering a few remarks on the class or variety of tree.

There is no better variety than the real Nak Naad or Coorg Tree. The Ceylon caste has hitherto failed in Munzerabad and the "Chick" (so called from Chickmuglore) is as best a gross plant, only suited for cultivation under dense shade, and is proverbially a biennial bearer.

The Liberian Specialité, as hitherto introduced, may be said to be a failure except under a system of pampering, which could not be arranged for on a large scale in practice.

The Ceylon Seedlings in their infancy developed Hemileia even in the two-leaf stage. The Coorgs rarely are attacked before the regular Leaf Disease season, but withstand the effects much better. Indeed the Coorg variety is for all purposes the best, being robust in constitution, and very prolific. The Ceylon plants never seemed to recover from the Leaf Disease and lost all their leaves and remained stationary,and after frequent trials have been pronounced a failure. Great care of course should be taken in the selection and preparation of seed, and only the ripest berries, off the healthiest trees, should be chosen. These should be trodden out by coolies and when the pulp is removed, the beans should be mixed with either wood ash, or very finely sifted soil and wood ash. The whole should be freely mixed together, and a fresh supply of wood ash, added every day. The best plan is to spread the mixture on mats in a light airy store, but the sun is on no account to be allowed to *see* the preparation. After frequent moving and change of wood ash &c. in about six days the seed may be considered ready for transport, and if it has to travel a distance, or be kept any time, great care should be taken to pack it in good bags, either with a plen-

tiful supply of wood ash, or good dry saw-dust or poundings of cherry Coffee.

To form a Nursery, too much care cannot possibly be taken about digging and draining. A good site having been chosen, where a plentiful or at least an adequate, supply of water is available, the whole is well dug up to the depth of a foot.

All stones, roots and logs are carefully removed and carried to a distance. If the ground is naturally damp and swampy, drains are dug about 3½ feet deep at intervals, and care is taken to run a main drain so as to intercept any springs which may emanate from the surrounding high land. One of the first principles of drainage is to intercept, and divert, the source of supply; and then by a series of secondary arteries to endeavour to free the land of all water held in suspension in excess of requirements. For a soil to carry out, or at least favor, the germination of seed and the growth of a plant, it must be of a certain temperature. A soil holding excess of water in suspension, either from the presence of too great a proportion of clay, or being mechanically out of condition, is proverbially found to be "cold" and such in practice is always found injurious. The suns rays are entirely expended in evaporating the water; the surface is always found to be hard, and frequently to crack, and the plants are yellow and sickly, and steadily refuse to prosper. The "contour-system" of drainage is undoubtedly the best and should always be adopted; in other words an arc of a circle—or even a line in the shape of a horse shoe should be marked out on the superior side of the site chosen, and the drain dug, should be at least deeper than the small arteries which may be made to empty themselves into a main channel traced to *cut,* or sap the lowest possible level. If terracing has to be carried out a line of pegs should be laid down showing where the superior cut-

ting has to be made, and another row should be driven in on the lower, or outer side, indicating the height to which the revetment has to be raised. A Ceylon Road tracer is invaluable for this sort of work, and after a little practice much extra labor and confusion may be avoided. If the ground is naturally very steep, it may be necessary merely to make small terraces; but where the ground permits, it is always better, in forming a permanent Nursery, to make each terrace as wide and regular as possible, as in future years the land may then be cultivated or prepared with the aid of the plough and harrow, which of course, mix and pulverize the soil much better, than if done by manual labor, and also perform the operation much more economically. Previous to making the "*cutting*," all *jungle* and *surface* soil should be heaped in a long mound in the *middle* of the space proposed to be terraced;—the "cutting" is then made, and the *formed* or lower side is raised with the SUBSOIL until it covers the row of pegs; or until the terrace is formed, having a slope inwards, of at least one in forty, to allow for subsidence.–The upper half is then freely dug over with the pickaxe, after which, the mound of surface soil is levelled evenly over the whole. In this way the whole terrace is covered with good soil and the plants near the *cutting* grow as large as those near the revetment. The terrace can now be laid out as desired; the favorite method being, to make the beds 4 feet wide, running across the terrace, each separated by a small trench-like path of one foot nine inches in width, and about six inches in depth, so as to carry any surface drainage to a trench made on the inner side of the terrace. All the beds being raised, and prepared, a lining rope is stretched transversely, from end to end of the terrace, and a line of men or boys with mamoties cut a small drill about two inches deep; the rope is then removed six inches, and the operation is continued until the lower end of the bed is reached. A gang of women then remove all clods from these drills; nicely round off the intermediate spaces. In this operation

all the fine pulverized portions of the dug soil, fall into the little drill-trench, which when finished, is barely an inch deep, both sides being well sloped outwards to prevent the soil closing in on the seed. In old Nurseries a little well rotted manure may be applied to each drill. The seeds are now simply *placed* in the drills at an inch apart but no soil is permitted to cover them—the whole surface is then covered thickly with dry jungle leaves, care being taken to discard all such as are large or heavy, which are apt to make the seedlings grow crooked. The beds are now ready for the water, which should be applied either in the morning or the evening with a watering-can with a fine rose. Too much moisture is decidedly bad; and irrigation is absolutely pernicious. An even, and *well maintained* state of moisture, is all that is required—more especially in hot sunny weather when one day's neglect may ruin a large percentage of the seed. In six weeks the seed will be raised above ground on its tender little stem and then a little extra care is necessary. As soon as the root has penetrated the soil some of the dry leaf covering should be thinned away, and immediately the little seedling is erect, all the covering may be removed with the exception of that which has become pulverized either by being moved about, or by decay. The plants may now be thinned out to four inches in the drill, each being cut out with a small round pointed knife, so as to have a small ball of earth about the size of a hazel nut:—this facilitates greatly the operation of pricking out and entirely obviates all chance of careless coolies "hanging the seedlings," which they invariably do, if this plan is not adopted. A few baskets of well pulverized soil is now scattered over the beds and the whole being well arranged with the hand the operation of thinning may be considered finished. Hand watering is decidedly to be preferred, and to facilitate this operation, little wells may be made at convenient distances in which the children can dip their chatties. Tar barrels with one head removed and sunk in the ground make

splendid wells, and last for many years, and always look clean and tidy. No weeds of any sort should be allowed to grow; the beds should be picked up regularly once a month. In the hot weather it is an excellent plant to thatch the surface of the beds with dry jungle leaves or old straw. This prevents the soil cracking, as it is very apt to do, being watered in the hot weather; and besides this a certain amount of water goes a longer way, and does not evaporate so rapidly,—in fact moisture is thus easily maintained. All watering should be done in the morning or evening, and never during the heat of the day. A Nursery should not be too rich, neither should the plants be unnecessarily "forced." It is always better to let the change to the plantation from the nursery be a change for the better for the plants, and nothing but failure can be expected from transplanting a highly forced plant to a poor hill side where probably the hole has been made and nothing else done in the way of forming a fitting reception for the seedling which has been hitherto accustomed to every luxury and care. A plant when removed for planting should be *growing,* and should under no circumstances be at "a stand still." A hastily grown plant probably has several primary branches and may have very few roots. Obviously the reverse is what should be desired,-a robust plant with perhaps only one pair of primaries, or even without any; but with a healthy pair of young light colored leaves at the top, and plenty of roots. Such when planted in a well filled hole never stops growing and evidently never feels or sustains any material check from the operation of transplanting. In concluding these remarks I should wish to draw attention to *Acclimatized seed.* Some years ago I procured some vegetable seeds from a well known firm in England and was greatly disappointed with the result. I however kept the seed of the first crop and sowed it the following season and gave some to my friends. There was a marvellous improvement, and I and my friends without exception had the finest vegetables that had ever been produced in this Talook. Elated with success we again

retained a supply of seed, and the result was a miserable failure. Two seasons ago I carefully selected some seed off my healthiest Coorgs and gave it to a brother planter who was making a new clearing in virgin forest about 20 miles to the west of my estate.—My friend also procured seed direct from Coorg and the result was most interesting. The acclimatized seed produced excellent plants, which although planted out have shown no signs of Leaf disease; whereas the plants raised from seed grown in Coorg have, though planted under precisely similar circumstances, and in the same Nursery lost nearly all their leaves since they have been transplanted. I may here mention that similar experiments conducted by me personally have shown the same result. This is merely a matter for consideration, and I feel it will prove of interest to those, who like myself, are struggling to get on. Much still remains to be learnt ; but until something definite is found out, I consider planters would do well to carry out a few experiments. Coorg seed grown in Munzerabad or Nugar, might perchance be found to be a fair exchange for seed grown in Coorg or Wynaad and very probaly each planter making the exchange might be benefited. Experiment in this direction is at least desirable, and I cannot conceive anything more likely to bring about success, than the introduction of carefully picked Coorg, or Mysore-Coorg seed into Ceylon, care always being taken to see that any attempt at acclima tization be performed in virgin soil so that the seed may be improved and not deteriorated. Among the Coorgs raised in Mysore I have noticed five *different varieties.* At first I considered such might be merely caused by change of soil and climate. At present having only trees ranging up to seven years of age, I should not like to speak definitely on the subject. As far as I can see however, I think such might be arranged, or classed as under :—

No. 1. The ordinary Coorg tree (Medium.)

No. 2. A grosser variety—bearing long jointed wood of immense length and thickness, with shorter and

more rounded, succulent leaves. Probably adapted for shade—but certainly an uncertain bearer.

No. 3. A very diminutive—but prolific kind,—an individual plant seldom being more than 3½ feet across, —leaves thin and wood very close jointed—seems to flourish well in poor soil, and is well adapted for exposed situations.

No. 4. A Hybrid—which has nearly always ripe fruit, flower and green berries on it at the same time—I consider this sort worthless.

No. 5. The Coorg "Chick"—closely resembles the "Mysore Chick" but appears a more robust plant when young.

It is a fact worth noticing that among the Coorg caste there are no "Celestials" or trees with branches ascending perpendicularly. Whether I am correct or wrong I still think that with care and experiment much of interest may yet be discovered.

In regard to the Liberian and Ceylon varieties I think that much yet remains to be learnt. The experiments hitherto conducted cannot be sufficiently relied upon, and I am of opinion, that the introduction of both descriptions must on no account be direct. Liberian seed produced in Ceylon and acclimatized in the "steamy atmosphere" of some of the more favored low-lands of Coorg might probably have a desirable effect, but the importation of plants in Wardian cases from England is only suitable for experiments conducted in well managed conservatories. I should much like to try seed of the ordinary Ceylon coffee plant raised in a comparatively dry district on virgin soil, and acclimatized under similar circumstances in the Bamboo of Coorg.

When making Nurseries, for the formation of new

Estates, I strongly recommend the use of a " steep" for the seed. Blue stone and water or lime water are used generally for such purposes by English Farmers. A weak mixture of Condy's Fluid and water might also be experimented with for this purpose.

Every mortal is prone to err and I feel sure I shall be only doing right, and shall be excused, if I venture to draw attention to a paragraph in Mr. Hull's book on coffee, page 67 of the old edition, and which has unfortunately been reproduced in the more recent publication of the same author.

The germination of the seed is thus described. "Let the " seed with its parchment be laid only upon a wet soil. A " pedicle peeps out, an extremity of which leans towards " the ground. Here two radicals are seeking and soon " grasp their nurse. The other extremity rears itself up " loaded with the whole seed. In a short time two Follicles " almost round and of a thin yellow colour unfold themselves " from the very substance of the seed and shake off the " parchment. The stigma or fissure seemed to mark their " separation on the flat side of the beam ; and on the round " side they seemed to be perfectly blended together and now " they part of themselves. Thus it is the seed itself " which spreads out into those two follicles which turn " green by contact with the air."

This I may say is erroneous throughout, and is rendered all the more puzzling by the use of the words *pedicle, radicals, follicles* and *Stigma* each of which botanically speaking is misapplied. Recently I had a most interesting conversation with a brother planter of the Cudoor District and I am not ashamed to say that I was found wanting in the knowledge of some of the stages connected with the germination of seed. As the subject is one of great interest in connection with the use of " Steeps" for the prevention of Leaf Disease and other hereditary complaints I venture to correct what I am led to believe is a prevailing miscon-

ception in regard to the somewhat mysterious process of the growth of the embryo plant within the seed, by giving an extract from Mr. Ferguson's instructive book on "Coffee Liberica."

" The first, second and third structures of this series
" belong to the fruit—whereas the others viz; the *testa,*
" the *albumen* and the *embryo* are essentially part of the
" seed.—The uses of the various structures which surround
" the minute embryo are to protect it from injury and at
" the same time supply it with suitable nourishment. * * *

" In the economy of plant life the albumen is a pa-
" trimony which the young embryo is supposed to utilize
" and adapt for the purposes of its growth and develop-
" ment—in fact it is a supply of food specially and wisely
" adapted to promote its first impulses of life and energy.
" When examined under a microscope the albumen consists
" of a number of cells, with walls more or less thick, forming
" a store house of nourishment in the form of starchy
" compounds, volatile oil and other vegetable products.
" If in a fresh mature bean we cut rather obliquely towards
" its base, we shall come upon a small cylindrical body com-
" pletely invested by the tissue of the albumen. It is about
" one third the length of the bean and looks like a small
" peg, with a round head. This is the embryo of the future
" plant and apparently now consists of only two parts.
" The narrow pointed part directed towards the base of the
" bean is the radicle. This in the process of germination will
" develop the tap-root, while the round head called by
" Botanists—the Plumule—will be found on examination to
" consist of two very minute fleshy leaves, the cotyledon
" ary or seed leaves of the young plant. Between these
" minute leaves is a process called the " punctum vegeta-
" tionis" or growing part of the ascending axis destined
" in process of time to give rise to all the various struc-
" tures of stem, branches, leaves, flowers and fruit."

It therefore appears clear that far from the substance

of the bean being capable of any actual metamorphosis it merely performs the functions of a matrix by nourishing the embryo with the albuminous substances of which it is composed, which to facilitate absorption, probably undergo certain gradual changes to suit increasing requirements. The rootlets once sufficiently developed draw nourishment from the soil which they rapidly penetrate, and a veritable seedling is the result, and it stands to reason that if the substance of the seed is imbued with some prophylactic steep and the ground freely mixed with some substance known to be inimical to Fungoid development, that the young plant would be healthy and that its constitution being as it were fortified it would be less liable to the insidious attacks of such pests as Hemileia. This I consider a subject worthy of careful attention and although I put forward my suggestions with the greatest diffidence I earnestly advocate both practical and persistent investigation.

CHAPTER 7.

VACANCY PLANTING.

The necessity for carrying out this important operation invariably engages the earnest attention of every Planter sooner or later, and much surprise and disappointment are generally occasioned when it is found that even with care and attention to all ordinary planting rules that "supplies" frequently refuse to "take" as readily as was expected. The operation of planting-up old land under any circumstances is always attended with a great deal of trouble and all who have tried it, are at once convinced that much still remains to be learnt. Even the most scientific authorities find a difficulty in defining the laws accurately, which are involved in this abstruse problem of Nature's economy—but it is well to know, that every description of Planter, experiences similar difficulties, and although much persevering research and enquiry have been conducted the reason why land that has been once cropped with certain classes of perennials refuses to grow supplies or a second stock of the identical variety of species with the same readiness and freedom, is not at all well understood. Hundreds of reasons may be urged, but in argument, one after the other, rarely stand the crucial tests of scientific investigation.

The subject is generally shrouded in mystery and is one well deserving of further enquiry. Some authorities are of opinion that exhaustion of, or predilection for, particular elements of plant food, is the cause, while others think, that after a certain species has been produced for some time, that certain structural alterations in the physical conditions of the soil are induced. The danger here lies in the chance of mistaking an effect for the cause. Where a plant, or a

tree, of one species prospers, where one of another species refuses to grow, a credible explanation may be found in the knowledge that one may be a surface feeder; and the other one of a class that obtains nourishment from a greater depth. However the subject is viewed, there are difficulties, more especially when we consider that all around, trees of the very same species, we have a difficulty about, are growing and flourishing. I think we may safely infer that in each of the reasons above given there is undoubtedly much truth; each circumstance probably contributes its quota to the difficulty, and I think in regard to the fact that full grown trees continue to flourish where young ones refuse to come on, we may even venture to conclude that the theory, that plants actually have the power of directly contributing towards the operation of "cooking their own food" must have some truth in it. If this be allowed we might argue that a particular class of tree having been grown on a certain spot that it had exhausted all the essentials of plant food which were in a state favorable for *immediate* assimilation, and that a young tree had not sufficient development to attack the remaining store of *crude* inorganic constituents which a fully matured tree had no difficulty in doing.

A change in the variety of plant frequently is attended with most satisfactory results, and it is a well known fact, that in all Garden culture and even in Forestry, many expedients are resorted to, in order to obviate the well known difficulty of raising supplies. The vacancies in a Hawthorn hedge are often supplied with a Black-thorn, or even with a Bramble;—and after an Oak Forest has been felled there is still a fortune to be made with Larch or Fir or kindred species of soft wooded trees. Some few years ago I was attending on an eminent Professor who was conducting a Chemical analysis of some soil with a view of ascertaining what was deficient—after Coffee had been grown for a number of years. I had supplied him with samples of virgin, and so-called, exhausted soil, and the analysis had been most scientifically and carefully conducted. I awaited the verdict in almost

breathless silence and my readers may imagine my disappointment when I was informed that although different combinations were present still all that was apparent was a slight diminution in the amount of Phosphoric Acid, Sulpuric Acid and of *Lime*. I was anxious for further advice so I ventured to press the subject of the vacancy difficulty somewhat lengthily for explanation, and was met with the stereotyped reply—that in practice, the *condition*, and not the *amount*, of certain constituents of the soil, influence its fertility. We then proceeded to examine the result of the Mechanical analysis and this showed very marked differences between the two samples. The soluble matter in the virgin soil was of course greatly in excess—and after incineration, the residuum was infinitely less than that of the soil which had been frequently cropped, In this I was informed I might recognize, one at least, of the most telling reasons of failure, and since in practice I have found such to be true. Although undoubtedly, I do not for an instant think that the mere presence of an excess of organic matter would constitute fertility, yet I am decidedly of opinion that for many reasons such is a requisite essential of any soil otherwise suited for the cultivation of coffee. Humus is not only the most hygrometric soil constituent, but it tends to reduce any cohesive tendency that may exist—it is the great reserve fund for the production of Carbonic Acid, the active agent for preparing plant food; and by its dark color secures for a soil the full benefit of the sun's rays. The decomposition of Humus however must be *continuous*, yet *gradual*, and hence, the absolute necessity of clearly appreciating the wide difference between a soil that holds moisture merely in diffused suspension, and one that rapidly becomes saturated and persistently retains it in bulk like a sponge. The soil in a virgin forest is granular and sweet,—it readily absorbs water, and has the power of retaining a sufficient amount of moisture without preventing the permeation of air. A soil out of condition readily takes up water also, but once saturated it remains so until such is ac-

tually evaporated by the sun. No air can possibly gain admission into such a soil as every pore is full to excess of water. The continuous and gradual process of decomposition is therefore entirely checked, and plants growing in such a soil are absolutely starved and frequently poisoned by the noxious combinations which result. Insoluble humates, silicates, and protoxides, are formed, each of which exert a most pernicious influence on vegetation. In virgin Forest soil, a young plant finds every condition present calculated to favor its growth; but after the land has been cropped, worked, and exposed, every obstacle that can be imagined, seems to put in an appearance, and it devolves on the cultivator to endeavour by artificial means to remedy the evil. Although with Coffee a rotation of crops cannot be instituted, still we may at least try a change of seed, and even better, a change of variety of plant. Every Gardener knows the peculiarities of disposition, and requirements, of the various, varieties of Rose or Fruit tree. We all know one variety to be hardier than another; and also in the vegetable garden we are frequently made aware that one sort of Lettuce or Carrot will thrive when another absolutely refuses to come on. In Coffee the same is undoubtedly the case, and it has recently been proved beyond a doubt, that be the technical reasons what they may, a change of seed, and also of variety are the first steps towards success in the matter of vacancies and reclamation. We must not however run away with the idea that we have solved the problem entirely, as experience shows us that a great deal is required in the matter of care, and attention to the management of the soil in which our operation of planting is to be performed, as well as to the rearing of the plant in the Nursery, and the method employed for establishing it permanently in the plantation. Any attempt to "*Stick down*" a highly forced plant in a hap-hazard sort of way will surely result in a failure, and it would be preferable to take a bundle of plants and bury them in the nearest ravine, than to take the trouble of planting them out in a weedy and otherwise neglected field of Coffee. I

have already endeavoured to suggest the requirements in regard to the rearing of plants in the Nursery, and will now say a few words relative to their removal, and the preparation for their reception in the Estate. The hole should be made as early as possible in the season, should be deeper, and wider than those usually made, and the land should be kept clear of all weeds. In the moonsoon of the previous season all weeds and forest debris should be carefully collected, either in the renovation pits, or in heaps on the surface, and as soon as the weather is fine enough, the land should be well dug over with the pickaxe. As soon as convenient, a supply of well rotted cattle manure and wood ash should be conveyed to the spot, and after the holes have been made, a small quantity should be placed alongside of each,—in the line,—and this should be well mixed with the vegetable manure from the renovation pits, or the bottom of the heaps above referred to; care being taken to remove all sticks or undecayed debris. Two days after the first shower filling should commence. The surface soil of the rows between the lines of holes should be drawn over the manure and then well mixed with the same, and each hole half filled with the mixture. This should be then firmly trodden down and more added until the surface is reached and then a large heap should be made on the top of each hole with all the best portions of the soil which was originally taken from it. In utilizing the soil in the rows, great care should be taken to prevent the cooly shelving in the sides of the hole, as in ordinary filling-in in virgin soil;—endeavour to leave a raised rim of undisturbed soil around each hole. If this simple precaution is neglected the soil in the hole being loose, and the surrounding land firm, and probably out of condition; in heavy rain, the whole wash of the surface soaks into the hole, and so saturates the prepared soil that it becomes a perfect swamp. Thousands of plants are ruined in this manner yearly. The peg is now simply placed on the top of each little mound marking the hole, and the operation of filling is completed by levelling the surrounding space to

prevent the formation of puddles. As soon as the monsoon has commenced, and taking advantage of moderate weather, planting may begin. At the lower end of each bed of the Nursery a small trench is dug, from which the soil is well thrown back, and each plant is cut out with a small square ball of earth attached to its root. A round pointed knife called a "Butcher's knife" is the best for this operation. The balls of earth need not be large; about thirty plants are generally easily placed in a basket. For this purpose the large sized "Eachul Muncray" is the best, as it is stronger and wider than the ordinary "Wartee" or "Bamboo" baskets. The plants are now carried to the field, and one having been laid carefully along side of each hole, the planter's business commences. If the work is on a hill side it is always right to begin from the crest, and work downwards, so as to enable the cooly to attend to the straightness of his line. Each planter is supplied with a small flat bamboo peg, the blade of which should be three inches wide; with this he levels the little heap covering the hole, and arranges the loose soil, so as to be slightly raised where the plant is to be established. The peg is now pressed into the prepared soil of the hole and moved edgeways,—laterally. The peg being removed, the hand is introduced, and the soil drawn down towards the operator forming an angle of 45° with the superior side of the slit, against which the plant is now placed, and the soil returned with a firm pressure of the hand. Great care should be taken not to allow planting to be done too deep. An inch about the *crown* of the root being amply sufficient. The surface is now nicely arranged with the hand, and the peg used in lining, is firmly placed in a sloping direction, across the plant, on the windward side, to act as a support. Weeding should be strictly attended to, and the whole of the rows must be well lifted with the pick as soon as fine weather appears. Surface drainage will even still more tend to make the operation a success, but such is often conveniently carried out the following season. The above system I have person-

ally adopted for several years and I unhesitatingly recommend it as calculated to produce the most satisfactory results. Even after all this trouble, very little actual growth takes place during the first season, and it is not until the Blossom showers have fallen, that even a Coorg, will manifest any inclination to come on. The roots however have been spreading in all directions *in* the hole and only await the return of rain to extend their operations beyond it. Constant digging and mixing of the surface is absolutely necessary, and manure composted with wood ash and a little lime and Bone dust should be liberally scattered over the surface, and well mixed with the loose soil. The great aim must be gradually to improve the whole surface, so that the feeder roots may be well drawn out and may be able to find nourishment wherever they go. Year by year the cultivation may be deepened, the surface will gradually dry, and all roots will penetrate deeper in consequence. A gradual system of Sub-soiling and mixing may be pursued by deepening the drains and the renovation pits, and strict attention should persistently be given to weeding and other ordinary routine operations. A Planter's soil and his Banking account resemble each other closely. Once the current account is exhausted, or at least found to be insufficient for present requirements—funds must be raised from the deposit Account or investments must be realized. Plant-food must be looked upon as ready cash and the way that an unfailing supply is maintained and utilized without seriously affecting the Exchequer constitutes the word "Management" upon which, in all things so much depends. In regard to manure I may mention that Bone dust dissolved in cattle urine is a magnificient application. Professor Cameron's plan is the best and consists of mixing powdered bones with moist clay—this mixture is then put into watertight receptacles and daily kept saturated with urine. Each pit, cask, or cistern, should be well covered over with about six inches of decayed wood which is always to be found in every Estate—this prevents all escape of ammonia and acts in the

same way as Gypsum, which is used for the same purpose by most farmers in England. This preparation of dissolved Bones is finer than most Superphosphates that can generally be procured, which unfortunately sometimes contain as much as 25 per cent of Gypsum. The value of urine as a manure has long been reccgnized, and in the above plan we have an economical and efficient way of utilizing it.

CHAPTER 8.

PRUNING.

In touching upon a few points in connection with this important subject, I shall faithfully endeavour to adhere, to what I have already stated in my "general remarks" and must disclaim all intention of attempting to deal with the scientific pruning of *new* Estates. All I shall venture to do is briefly to point out where danger generally threatens, and endeavour to add to the general knowledge of the operation, which I deeply regret to say is not so generally appreciated as it should be. As before stated my remarks will more affect the treatment of old, and hitherto badly pruned, coffee, than tend to explain the principles of really scientific pruning. As, however, in Mysore a great number of young hands have not had the opportunity of judging for themselves as to the exact period at which mistakes were formerly made, I think few will object, if I first tread gently, on dangerous, and to me forbidden ground, merely as a precautionary endeavour to save more from following in the steps of those who have gone before them. My great endeavour is to give matter for consideration, and I hope thus to elicit advice and assistance from practical members of the profession to which I have the honor to belong. Why as fellow workmen not let each other know where the slippery places are in our path of daily routine? Why not by every endeavour in our power strive to allow the fresh blood and energy of our younger hands be turned to advancement; rather than oblige every new comer to find out everything for himself by the tedious process of experience? Many mistakes may be easily avoided, and much danger guarded against, by a few timely hints; and barring a good practical insight into the more ordinary operations of daily occurrence I always think it is a pity to let a newcomer trudge over all the circuitous paths of error and misconception which in the absence of a friendly warn-

ing are inevitably tried one after the other in dealing with works, the effects of which, cannot be judged of for at least several years. Fresh energy should always be utilized, I maintain, in developing and improving systems of general culture, and in order to obtain the full benefit of such, all fallacies should be freely exposed and every endeavour made to have all mistakes, dangers, and known misconceptions, clearly marked out on the Chart which has been tediously prepared by dearly bought experience. The very best book on Coffee planting is that written by Mr. Hull, and for all general purposes I consider it an invaluable work, and one which every one who is interested in the enterprise should seriously peruse. The chapter on Pruning gives a graphic description of much that is necessary, and I almost feel a delicacy in attempting to touch on a subject which has already received attention by such a competent authority. My diffidence however, is considerably modified when I remember that to some, much depends on the way in which things are presented for their consideration, and as my object is merely to assist rather than to instruct, I will without further comment give a somewhat lengthy extract from the Dictionary of Daily Wants* which 1 consider gives general, concise, and valuable information on the reasons and objects of Systematic Pruning.

I make a few alterations to suit Coffee, which will be noticed by the italics.

" In gardening and the culture of fruit trees pruning " denotes the removal of *all dry, useless* and superfluous " *branches* and portions of trees with the view of *making* " them, more fruitful—more *regular in form* and with great- " er regularity to produce larger *crops.* If carried to " too great an extent the desired result is not obtained, for " every tree requires a certain amount of leaf surface for the " elaboration of its sap, and therefore if this be reduced too

* Page 808.

"much, blossom buds are produced less abundantly, for "leaves are more necessary for the health of the plant and "by a wise provision, the parts less requisite for individual "vigour are superseded by the parts more needed. On "the other hand if the branches are left too thick they "over-shadow those beneath them and so exclude the light "as to prevent that elaboration of the sap without which "no blossom buds are formed; but induce an excessive "production of leaves in the vain effort to attain by an "enlarged surface that elaboration which a smaller sur- "face would effect in a more intense light. The season "for pruning must be regulated in some degree by the "strength of the tree, for although, as a general rule the "operation should not take place till the fall of the leaf "indicates that vegetation has ceased, yet if the "tree be weak, it may often be performed with ad- "vantage a little earlier, but still so late in the "Autumn as to prevent the immediate protrusion "of fresh shoots. The chief guide in pruning consists "in being well acquainted with the mode of the bear- "ing of the different sorts of tree—*the peculiar caste of tree* "*and the circumstances under which it is cultivated,* and "forming an early judgment of future events of shoots "and branches and many other circumstances for which some "general rule may be given; but there are particular instan- "ces and requirements which cannot be judged of but upon "the spot and depend chiefly on practice and observation.— "Young shoots require thinning to preserve the beauty of "the trees and to encourage the fruit, and the sooner this "is performed the better. It is therefore advisable "to begin early in May removing all superfluous growths "and ill placed shoots which may be done with considerably "more expedition than when *such have attained* a consider- "able length. When however a tree is inclined to luxu- "riance it is proper to retain as many of the regular and "*properly placed* shoots as can be commodiously trained "with any regularity, in order to divide and exhaust the too

" abundant sap. It will be necessary to review the trees *frequently* in order to reform such branches or shoots as may " have taken a wrong direction—and to remove any fresh " irregular shoots—and as the already selected ones ad- " vance in length to regulate the supply of young wood.

" *Always cut upwards, and in a sloping direction— " Prune so as to leave as few wounds as possible, and let the " surface of every cut be as even as possible—Let the general " autumnal pruning take place as soon as the gathering of the " fruit will permit—Lastly use a pruning knife of the best " description and let it be, if possible, as sharp as a razor." The above remarks are no words of mine but are written by some eminent authority on Garden Culture, and as such, are decidedly worthy of perusal, and I only too deeply regret that I had not the advantage of such sound general advice myself some fifteen years ago, when I distinctly remember, the only so-called authorities on pruning available in Mysore were a Doctor in a Dragoon Regiment who strongly advocated cutting every tree down to six inches from the ground; and an impetuous tyro of a planter, who studiously cut all the primaries back to the first eye, in order as he stated to have another fair start. I will now casually touch on the first steps in pruning, which in young trees consists of Topping, a measure adopted to transform a tree, naturally inclined to grow tall and lanky, into a manageable shrub condensed and compact and better fitted in form and nature to bear a larger crop on a relatively more confined surface. The operation of Topping throws the whole energy of the tree into the few branches which are destined to be considered as foundations for elaborating horizontally the sap and vigor which would have been expended in adding to the vertical increase of growth and development and such branches are therefore, after the operation, even more deserving of their proper name primaries—or mother branches,—and as such in their infancy,

* Page 482

maturity, and old age, should be well cared for, and scrupulously respected. Topping a tree immediately influences these branches, makes them more juicy and robust, and causes them to produce an abundant supply of crop bearing wood in the form of secondaries and tertiaries, which after the first few years of the plants existence have to be manipulated, removed, and renewed, in order to maintain the tree in a bearing condition. A forecast of the probable requirements consequent on aspect, climate, and general position; and a careful estimate of the probable quality of the soil, are points deserving of peculiar consideration in regard to Topping.

In exposed and windy situations it is obvious that it would be unsafe to venture on a tall tree, in the same manner as it would doubtless be unwise not to retain a sufficient amount of crop bearing surface, to secure the full advantage of a rich and sheltered valley.

Two,—to, two and a half, feet is an excellent height for doubtful, or even somewhat exposed situations and in sheltered hollows and on gentle slopes, even four and a half feet may be safely tried in virgin soil. In reclamation, however, it is a fallacy to dream of tall trees. Such *should* only, and *can* only, be depended upon where the soil is undoubtedly rich, and any attempt to grow a tree above three and half feet in height in old land, must at once be pronounced a mistake. Both for new and old land three and half feet should be considered a most desirable standard, and wherever the soil is known to be poor, or is considered doubtful, it is much safer to have even a foot less than to venture on any uncertain experiments.

On a South face I must say I always prefer a short plant as such expands and covers the ground much more rapidly and undoubtedly stands the ordeal of drought much better.

During the recent famine year in which only about half the usual amount of rain fell—I was even more than ever convinced of the advantages of short trees, particularly in old land. Those topped at three and a half feet suffered the most, and many fine young trees lost three and four pairs of primaries, while those topped at two and half feet were busy making shoots, and daily increasing in vigor. The further advantages of moderately sized trees are also apparent in the fact that much more work can be carried out by children, more especially in the matter of removing suckers, and in crop-picking, one has absolute immunity from that dreadful practice of the bending down and breaking of branches. The pleasure of superintending work is also greatly enhanced and the coolies are able to carry their baskets without spilling and wasting the cherry and with much greater ease and comfort to themselves. I have adopted with very great success, the system of Topping, which consists of removing the top and only *one* primary. This I have found is by far the best principle for shade coffee, where branches, dry bark, and rubbish are constantly falling from the jungle trees. I find there is no such liability to splitting as I found when, either only the top, or the top and both primaries, were removed. After the first full crop pruning is absolutely necessary, and even sometimes sooner, but in the latter case, the knife should not be allowed, any dry or useless wood being merely gently removed with the hand. One frequently sees some of the primaries on a young tree die back after producing merely a few stray berries, and if the knife is used, the probability—nay, the certainty, is that some careless cooly will whip the whole branch off as it "looks bad." I would strongly recommend that appearance be sacrificed for utility. Even the most careful cannot tell how far the sap has receded and for all purposes it is best merely gently to break the dry part off, always being careful to hold the centre of the little branch tightly, and use no force in the operation. After the young shoots have made their appearance on the

primaries, all shoots are generally removed from the first set of eyes nearest the stem, and in close jointed wood even the first two sets may be removed from the uppermost three pairs of lateral branches which will form a clear space of ten inches or a foot in the centre of each tree, at the top, gradually narrowing like an inverted cone towards the ground. All shoots growing upwards, downwards and inwards are also removed and strictly speaking every alternate secondary should be removed also, as without this, the first pair are apt to take an undue share of sap, and by stinting those in front of them, not only occasion great irregularity, but frequently cause the absolute destruction of the primary branch. With the alternate distribution of secondaries, the primary is greatly strengthened and each secondary is as vigorous as its neighbour. When a tree is thus treated it is ready to bear a good crop and it would be well for every young planter to study Nature's arrangement and symmetry and having rivetted the same in his memory, endeavour to remember such as his pattern for future requirements. This vigorous well shaped tree is Nature's original model for future imitation, and if the form of tree best suited to bear a crop in the easiest way and to the greatest advantage, is once clearly remembered; in future years the execution and manipulation, connected with both handling and pruning will be very materially simplified. Such a form and such symmetry, cannot possibly be expected to result from indiscriminate hacking, or cutting to pieces, a tree already slightly debilitated with bearing its first crop. Care is absolutely necessary, add any work to be carried out with the knife, is much better extended over two operations than all done at once. All utterly useless, and dry wood may of course always be removed, and fresh alternate secondaries encouraged; but it is decidedly objectionable,—unless the planter is determined to uphold and maintain mathematical exactness,—to remove all wood simply because it has born crop, at perhaps, half a dozen eyes: It will bear again,

and generally much better, on its gradually increasing length, and in vigorous coffee will frequently produce magnificient clusters in places where crop was little expected. For this reason if a man is not absolutely an experienced pruner, and has not a really efficient gang of trained coolies accustomed to the work, it is much better to depend and rely on handling, than to allow the knife to be ruthlessly used. Nature generally asserts her rights, and if there is a difficulty, it is much better to wait, and watch, and THEN act in accordance with circumstances, than to attempt by the adoption of any rigidly enforced system, to obtain absolute uniformity in the thousands of individual plants which constitute a field of coffee. Each individual plant has its particular and peculiar requirements, and with uncertain attendance of cooly labor, apathy, and general indolence, to say nothing of inherent stupidity—which are part and parcel of the nature of most of the lower and laboring classes to contend against, it is certainly a pity to venture on any elaborate system before calculating as to the prospects of being able to maintain it. Uuder such circumstances it is certainly more desirable to restrict ones operations,—which must of necessity be on an extended scale—to endeavour simply to assist Nature, and not to adopt an intricate system which will absolutely throw the whole maintenance of future success on the frail resources of man. An ordinary intelligent pruner will with the aid of hand and knife and attention to a few general rules soon learn to keep a tree in fair condition, and one standing rule should be, to remember to do all quietly, thoughtfully, and neatly, and disengage from the mind the ruinous fallacy that heavy pruning or mutilation is either good for the tree or the Planter's purse. All suckers and cross shoots—all such as grow upwards, downwards, or inwards, regularly removed in the handling—all dry branches carefully broken back and pared with the knife—all moss and scales well rubbed off the stem and larger branches, and a general arrangement of new shoots to prevent absolute over crowding systematically attended

to—form for all general purposes a highly efficient and easily maintained system of general routine, and as such, should be more generally adopted,—particularly in regard to Coffee in which no scientific system has been attempted from the first. It is necessary to remark, in order to prevent all chance of misunderstanding, that Coffee cultivated as it is in Mysore under shade, is much less tractable than when grown in the open as it is in all neighbouring Provinces. Under shade it is simply useless to hope for success by the adoption of an elaborate system of training, as however well the shade may be distributed, a very large percentage of plants in immediate proximity to the Forest trees must of necessity require different treatment to those, that being farther removed, are merely laterally protected from the sun's rays at different periods of the day. Any attempt to produce a heavy crop on a few well arranged branches, as in the open, will undoubtedly result in a failure, and it has farther been fully demonstrated, that under shade, the joints of the bearing wood are longer, and the clusters of berries smaller, than those produced in the open. The growth of wood all through Mysore is very rapid, and it is absolutely necessary to remember what is clearly laid down in the extract from the Dictionary of Daily Wants relative to a "sufficient leaf-surface for the elaboration of the Sap"—I will even go further and say, that much must be done by careful watching, and wherever vigor is apparent, arrangements should be made to grow a correspondingly larger amount of shoots—but of course such must be done in moderation. When the leaf surface is sufficient to *"carry and utilize"* the amount of sap contained in the tree—suckers and constant flushes of new shoots which necessitate perpetual handling, are considerably restrained, the sap being appropriated by the selected shoots left for the purpose of producing crop. Under good cultivation the vertical sucker must be considered the *"Safety valve"* indicating the necessities of the tree, and after a tree has been cropped and pruned

several times, a frequent recurrence of *"Suckers"* should make the Planter aware that there is something materially wrong in his system of pruning and handling.

A close examination under such circumstances will probably result in showing that the trees have been too heavily pruned and hacked about. Jagged spines will frequently be found to mark where large branches have been carelessly removed, and such will be found in the process of rotting to have deeply cankered the parent branch and rendered the "eye" barren, so that no new shoot can possibly be expected again. As a Doctor would say a "structural deformity" has been caused and it is clear that if heavy and reckless pruning has been allowed for several years, the very "foundation branches," from which our bearing shoots are to emanate, have been permanently injured beyond all hope of recovery. It is to guard against such misfortune, and endeavour to assist at reforming "healthy foundation wood" that my remarks are aimed.

In the first place therefore my system is simplicity itself and consists as follows:—Do not attempt any elaborate system which is difficult to inculcate, still more so to maintain, and is otherwise unsuited, for all requirements in *shade* culture. Depend more on handling and the careful selection of new wood. When the tree is young, endeavour to give its primaries a fair start by adopting the system of alternate distribution of secondaries, and then carefully *assist* Nature by preventing absolute over-crowding. Remove all backward, upward, and downward shoots and wherever there is room, encourage tertiaries, which bear well and can always be safely and annually removed. Avoid the constant removal of large branches, and confine the operation of pruning more to a system of removing branches to add to the vigor of others *already* formed and growing,—rather than to periodical mutilation, in the *hope* of getting substitutes. Pruning if carried out under this plan, will

merely mean an operation of selection and thinning—in fact the removal of all that is useless, for the benefit of all that is healthy and required. Any ordinary cooly will readily understand the requirements of each individual tree at a glance, and the Planter will be saved innumerable troubles and anxieties. Gormandizers will simply refuse to grow under such a plan, and although a scientific pruner may be shocked at such sacrilege, still I unhesitatingly suggest this system as the only one suited for cultivation under shade. Handling and pruning must be made subordinate to each other, and if the former is carefully and skilfully carried out, the latter will be always simplicity personified. Too much care cannot be bestowed on handling and in the strict selection of healthy shoots. Two shoots should never be allowed to grow from one eye, neither should both eyes at the same joint, be allowed to be taxed at once. Once a shoot is selected in April or May it should be looked upon as confirmed in its appointment, and should be tended and assisted with untiring care. After the first selection, which should not be commenced until a sufficient time has been allowed for shoots generally to appear—no others of a subsequent growth should be permitted to remain.

After a month's hardening off, the selected shoots will be so much larger than any of the new comers, and also be of so much darker a color that even unskilled labor may be employed to remove those sprouts which are not wanted. All vertical suckers should of course be kept down; and by the time the heavy rains may generally be expected, the stock of wood for the coming season will not only be vigorous and healthy; but will be so far matured, as not to offer the Rot a chance of destroying it. After the heaviest rains are over much interesting work may be carried out in attending to these selected shoots which would of course include the "breaking back" to vigorous wood as before casually mentioned. This can be done during

the whole of the latter part of the monsoon, and only those who have tried it, can realize the absolute benefit which results. By the time leaf-disease is due all should be finished, and if this is the case, that dire scourge will find the trees better prepared to withstand its attack. When crop has been picked each tree is found to contain about equal shares of dry, useless wood, and healthy, vigorous shoots, and the operation of removing the former, and thus adding to the beauty and health of the latter, is one merely calling for a good sharp knife and a little ordinary care. We will now consider the process of remedying matters where heavy pruning has been carried on for a series of years, where the trees have degenerated into Crows-nests or Umbrellas, and where Gormandizers are the rule and not the exception.

A careful examination of trees under such circumstances, will show that if there are any primaries at all, they have been so hacked and mutilated as to be absolutely useless in their existing state. Any attempt to prune and lead out new wood from them would inevitably produce unsatisfactory results. Gormandizers would put in an immediate appearance, and any shoots other than such, would be long, whippy and useless. It is under such circumstances a fallacy to think that the knife must be applied recklessly,—such only makes matters worse; besides which the trees are too weak to stand such an operation. Everything must be done gradually and with a well determined object, but first of all, it is necessary for at least a year or so, that one pruning rule already enunciated, be relaxed. We have no reason for the clearing out of the centre, as perhaps at the most in an Umbrella tree there are not more than the mutilated remains of three or four pairs of primaries. Under these circumstances we must rather trust to getting light, air, and ventilation, by a general thinning out *all over*, than by any passage cleared down the centre for that purpose. The great aim is to take advan-

tage of " healthy eyes" WHEREVER they may be found, from which, to lead out shoots, on which in subsequent years to train and produce a vigorous show of good bearing wood. During the monsoon, if the trees are in crop, all small and dry wood should be removed with the hand, and any new shoots which may make their appearance, should be steadily encouraged and attended to; as leaves and lungs are indispensable during the treatment. After crop has been picked and the Jungle shade efficiently lopped and thinned, the knife should be lightly used to remove all absolutely useless wood. Such portions of the primaries as may yet exist should receive great attention, and all jagged evidences of previous mutilation should be carefully removed with the saw, and the wounds thus made should be well pared or dressed with a sharp knife, so as to favor the growth of the bark. A certain number of branches should be selected for treatment; but such should never exceed one-half of the whole number. Such portions of the primaries that are available should be allowed to retain two or three secondaries, and then be *docked;* and the secondaries shortened back to the fourth eye.* The appearance of a branch thus treated will be very much like a deer's horn, and such will doubtless be considered an unusual operation, but it must be acknowledged to be an improvement on a system of mutilation which reduced the foundation wood to a single peg. From the eyes of the secondaries,—shoots will soon appear, and as soon as these are sufficiently grown, one on either side of each *tine* should be left, and the remainder removed—preference being here again given to such as radiate well out from the centre. Care should now be taken to allow nothing else to grow on these tines; any sprouts appearing on the portion of the primary, or at

* NOTE.—Or in the event of the primary being too short a single secondary should be selected preference being given to one that grows well outwards, this should be shortened back so as not to measure together with the portion of the primary more than eighteen inches and on it two or three tertiaries should be left which should also be shortened back as above described.

the *junction*, should be promptly removed and monthly handing carefully carried out. By the end of the season, each original branch thus treated will have six fine healthy shoots which will bear crop the following year; once these are formed a further supply of old and useless wood from the other portions of the tree may be removed and other primaries subjected to similar treatment. In Handling and Pruning the following season care should be taken to allow no new wood except that appearing on the selected tertiaries, which are henceforth to be regarded as primaries. In this manner in two seasons all useless wood may be removed and the tree furnished with succulent foundation wood upon which any amount of fine close jointed shoots may be trained. If these new branches are well attended to and carefully handled, the appearance of what has emanated from each tine will be fanlike, and of course due care must be taken to prevent over-crowding, and a general routine of light pruning must be considered indispensable. In a year or so, the trees thus treated become wide and expanded—and the shoots emanating from healthy eyes grow rapidly and in the proper direction, and may easily be trained as desired. The communication between the stem and the bearing wood gradually improves, and the junctions between the mutilated primaries and the healthy arrangement which has been extended from them, is soon lost sight of; and when healthy circulation has been established those portions which used to be scaly and barkbound, rapidly become smooth and dappled with green. Nothing tends to bring this desirable change about, more than the careful paring away of all *spikes*, and the constant removal of any moss, which may appear. The endeavour of the Planter must be to *ease off the angles* of what we may call an *articulated substitute* for a straight primary. Nature will gradually perform this operation; but must be assisted,—as our substitute for a regularly jointed primary may be compared to a patched-up hose with water passing through it

at high pressure,—leakage is sure to take place at first, until every "kink" as it were is removed,—flushes of sprouts indicate the obstructions, and will certainly appear until a sufficient leaf-surface has been established to utilize the sap. Once the flow has been established in the desired direction, structural alteration of the cellular processes will gradually take place, and before long, all impediments are overcome, and a healthy circulation becomes permanently established. Some Planters greatly object to allow any wood but that of a secondary formation to remain on a tree; but in old Coffee under shade I have seen the wood, of even the sixth and seventh formation, bear an excellent crop. The plan I have advised converts a tertiary into a primary, the intermediate secondary being only perhaps six inches long. Such an arrangement permits the Planter to train several shoots at once which are able to "carry the sap" without degenerating into Gormandizers, which inevitably would be the case under any other system. All who have seen the result of this plan have acknowledged its benefits, and I unhesitatingly recommend it for trial where the condition of the trees from neglect and heavy pruning warrant the experiment. Although manure is decidedly necessary under such treatment, such must not be of too forcing a kind, and should be applied *gradually.* The Pickaxe should be freely used the first season, and all weeds scrupulously kept down with the hand. The stem of each tree should be well rubbed and cleaned with a coir glove, and any vegetable rubbish and debris in the line should be well distributed all over the area occupied by the feeder roots. A full application of manure is highly desirable *after* the leaf-surface has been moderately extended.

Whongie oil cake, wood ash, and cattle manure made into a compost are to be highly recommended for such purposes. Renovation pitting is also much to be advocated as an operation well calculated rapidly to reform or improve the surface soil.

CHAPTER 9.

SHADE.

ITS CULTIVATION AND MANAGEMENT.

Climatic conditions peculiar to Mysore render it necessary that the cultivation of Coffee be carried on under shade. Subject, as this Province is, to a variable rainfall and long periods of drought, any attempt to cultivate in the "Open" invariably results in a failure. In former years however these requirements were little understood and considerable misfortune was the consequence. The fact that shade was unnecessary every where else where coffee was grown, and the splendid results obtained in Coorg, Ceylon and the Wynaad, sadly influenced the discretion of many of the pioneers, at least in the Munzerabad Talook, which being healthy and freely accessible was the field chosen by a great number of new comers. Several immense clearings were made and innumerable small ones rapidly followed suit. The Jungle was cleared and burnt in the most approved manner, and many were the felicitations exchanged as to the "*good* burns" which had been effected "Hastily run up" plants, with wonderful promise soon appeared, and for a few years all was undoubted success. A couple of unexceptionally good seasons greatly added to appearances, and even two or three magnificient crops were gathered. The seasons extending from 1865 to 1867 however were of a very different nature—a drought of seven months following on an abnormally short rainfall, not only sealed the doom of all the Estates in the open, but even seriously affected many in the shade.

The Borer during these seasons appeared almost universally, but the loss although not entirely confined to the open, was yet decidedly heavier where clearings had been

made. The open system was then finally declared a failure or at least entirely unsuited for adoption in this Province. For several years attention was directed to the formation of new clearings under shade, and year by year, efforts were made to reclaim those portions where failure had taken place. Season after season these latter places were planted up merely to die out again in the following hot weather. Manures and high culture had no appreciable effect and finally many a block was abandoned in order to allow shade to spring up; but in many cases nothing but the rankest grass and most useless vegetation was the result. The absolute necessity of introducing a regular system of shade tree planting was now fully realized, but as the requirements of such an operation were entirely unknown much time and money were uselessly expended. Many built their hopes on the "Charcoal Tree" (Sponia Wightii) which is too well known to require description; suffice it merely to say, that such was subsequently found to be perfectly unsuited for the, requirements of reclamation, although useful for many other purposes. The seed of the Ponciana Regia and Cassia Florida were next introduced, and extensive Nurseries made. Every tree that was planted out succeeded and grew rapidly, but it was soon found that the Ponciana at least had an absolutely pernicious effect on the coffee, which languished and nearly died all around it. The axe again came into use and the Charcoal and Ponciana were removed and converted into firewood for the surrounding population, who alone benefitted by the experiment. In one year I felled over 40,000 of these Gold Mohurs. Would that they had been Gold Mohurs of another description ! ! I had procured the seed by the maund from Madras and Bengal and had carefully raised the plants in Nurseries, whence they were removed and planted like Coffee, in holes in the Estate. A good axeman had some difficulty in disposing of a dozen in a day, as many were three feet in circumference,—the wood however is very easily cut, and as I remarked before, makes excellent firewood and charcoal. The Australian Wattle and

a host of other imported varieties were tried in vain, some of the seed actually refusing to germinate, probably as a brother Planter remarked, owing to their unpronounceable Botanical names having been put on tickets in the beds.* Jack seeds were procured from the open Country, and the Ghaut, and came up to form refreshment for the herds of Monkeys which frequented the Estates. Fortunately while these experiments were being conducted every endeavour to raise trees of indigenous varieties was energetically made, and the Mysore Planter is now well aware that for all purposes such are the best suited for his requirements, and as such, call for increased attention. I will now proceed to notice some of the best descriptions and for the sake of general perspicuity, I will make my remarks apply to a clearing which has been abandoned, as I before remarked, for the purpose of allowing shade to spring up.

In the hot weather a gang of coolies should be sent to weed the clearing with the grass knife, and during this operation strict orders should be given to remove nothing that has the semblance of a jungle tree or its seedling nothing but absolute weeds, grass and creepers, should be removed. Fire paths should be systematically cleared,—all old roads and paths being utilized for this purpose. As soon as the first rain falls the ground should be well turned up with the pick-axe, after which operation, a gang of a dozen or so good local boys, specially selected for their superior intelligence, should be deputed under the charge of an active Duffadar, to go steadily up and down the clearing and look for the seedlings of Jungle trees. At first considerable difficulty is experienced in distinguishing a seedling from a weed; but after a time and a little experience, it is perfectly astonishing to watch the improvement, and I may here clearly state without any fear of contradiction, that a good intelligent local cooly or

* NOTE.—Sterculia Alata—Spathodia Crespa—Sterculia Fœtida—Sterocarpus Marsupium—Sterocarpus Dalbagaorides—Ailanthus Excelsa—Cathartocarpus Roxburghü.

Duffadar, knows more about Botany than many so-called adopts. It is positively an exception to the general rule to meet a local who does not know the name of nearly every weed and creeper as well as that of most of the jungle trees. His knowledge is however local also, and only extends to the class of jungle to be found near where the lives. I have frequently brought a bough, or a few leaves from the jungle, and made enquiries as to the name of the tree from which I had taken it, and been surprised to find that the coolies knew all about it. Here and there one meets a native of superior attainments who can, if he pleases, give all requisite information as to whether the tree is deciduous or not,—the time it makes its new leaves, &c., and can also give good sound advice as to what trees are suitable for timber, and as to the time for felling for such purposes. No Native will cut a tree or Bamboo for building when the moon is bright as he well knows that insects will rapidly destroy it. It is a good old native custom also in regard to timber, to cut, rough adze, and then allow the beam to lie for several months in a tank. To return to our subject, I repeat that amongst the raw material available in Mysore, the Planter finds, that after a little practice on the coolies part, and patience and strictness on his own, he is able to get gradually a gang together, that can be fairly trusted to discriminate between a young jungle seedling and a weed. Every seedling found is carefully attended, all weeds removed with the hand, and a jungle peg or stake, fixed near it. In places, perfect Nurseries are found, and these of course receive extra attention. The young seedlings can be safely removed and pricked out in properly laid out beds formed on a suitable site near a Tank or Stream, and can there be duly attended to—but it is always better to leave individuals where they are found. In this manner, in the course of a season, thousands of good caste seedlings may be raised and protected; and gradually as experience improves all useless, varieties may be removed, and attention confined to those that are really required. Nearly

all trees of the Ficus tribe can be raised from cuttings and I only know one of this group that is useless and that is the sand paper tree (Gerguttee) or Ficus Asperrima. The Black Busree and the Aldu, are both splendid trees for shade, and the Gonee another of the same tribe grows rapidly and forms a magnificient tree. The Uttay (Ficus Glomerata) is however par excellence the finest shade tree known being clothed in magnificient foliage all through the hot weather and becoming entirely denuded of leaves in the monsoon, when no shade is required. This tree can be raised both from seed and from cuttings. The best way to treat the seed, is to procure a large supply of good ripe fruit, which should be well broken up by the hand, freely mixed with well rotted manure, and thrown broad-cast on prepared and shaded beds, and gently watered. The cuttings are made from the branches and should not be larger than a pencil—twigs in fact—these at the beginning of the monsoon should be planted on raised beds of well dug soil in which a plentiful supply of old manure has been mixed, and which should be formed in a moderately shaded situation. At the beginning of the monsoon lots of young plants may also be obtained from the margins of village manure heaps and in and around ruined houses, or villages. All these should be brought in by *Scouts* who should be regularly sent out for the purpose. Difficulty is sometimes experienced in getting the Uttay seed to germinate freely; much depends on the tree from which the fruit is picked being robust and healthy. The experiment of using the dung of cattle stall fed on the ripe Figs—has been attended with frequent success and several fine Nurseries have been raised in this manner. In regard to the larger cuttings of Busree, Aldoo, and Gonee, I have found the following plan the best. Holes should be made about 2 feet deep with a Crowbar, and should then be about three parts re-filled. The cuttings should be procured, and collected in one place, and should be about six feet long, and have a fork left at the top. These should be

cut as soon as the soil is moist at the beginning of the monsoon and should be allowed to lie in a cool shady place for three days,—this is to allow the sap to thicken—otherwise they are likely to "bleed" too freely. A few coolies are then sent, and each stake should be held in the hand, and the lower extremity cut like the mouth of a flute with one stroke of a sharp Bill-hook or "Curcuttee." These are now taken to the holes, and pressed firmly into the new soil—care being taken, not to allow any force to be used, as such would fray or peel the bark; the remainder of the soil is now filled in, well trodden down, and a little cowdung and mud, which has been previously well mixed together with water, should be smeared over all the wounds made in forming the cutting. If the operation is successfully managed, shoots will appear within twenty days or a month. The first time I tried these cuttings I made a very foolish mistake and as others may perhaps follow my example I may as well relate what I did. I duly made the holes,—but did not fill them. I carefully prepared the cut tings—but cut the ends off without leaving a slope. I then proceeded to put a stake in each hole and filled in the soil. Out of 6,000 I only now have a few representatives. The young roots doubtless appeared, but found nothing but a hard bed of gravel for their reception; and I only found out when too late, that such proceed from the bark where it is cut, and do not come out laterally until the cutting has firmly taken root at the bottom. A moment's reflection will clearly show that even the native method of sharpening to a point, and then driving in like a hedge stake, had a better chance of success than my first attempt. I have seldom had failures since and have now thousands of luxuriant young trees ranging from 30 to 40 feet in height and giving excellent shade to the coffee below. With care, culture, and due attention to judicious lopping, a slight covering for coffee may be produced under favorable circumstances, in 10 years; but the operation requires lots of care and a liberal expenditure.

Lopping should be gradual. The first step is to reduce every plant to one stem, and when it is about four feet high, it may be gently treated by having all branches too near the ground removed with a sharp pruning knife. Once it is run up, the operation becomes easier; but heavy lopping like heavy pruning, is decidedly bad. Every thing should be done by degrees, and the truth of the old saying "done in haste and repented of at leisure" is here fully exemplified. A young tree recklessly lopped, has its growth checked at once, and like a coffee tree, immediately throws out a profusion of suckers,—becomes sickly,—and in addition to this; the leverage caused by the foliage is frequently so great, that the sapling is twisted and broken by the wind. In lopping, a very sharp curcuttee should be used; and the cooly standing at the root of the sapling should remove the branch with one stroke,—the cut being made on the side of the branch, from within, outwards. The removal of a large branch always injures a tree—therefore lopping should be early attended to. Where a thick branch has to be removed, it is better to shorten it back, and in the following season remove it altogether with a saw. A *Grecian* saw is the best, as the teeth are arranged so as to cut when the instrument is drawn towards the operator. If the coolies have to climb the trees, Bamboo ladders should be used; which merely consist of a single Bamboo lopped so as to leave pegs about six inches long on the alternate system. In the absence of such, the coolies are fond of cutting notches in the trees, which is a most objectionable operation and should never be allowed.

In removing a branch from above; an incision is first made *underneath,* and then cuts should be made on *each side;* and the moment any bending is noticed, if a single sharp cut be applied on the *upper* side, the bough will fall clear of the tree without drawing or skinning the bark. Each lopper should be provided with a belt like a Toddy

M

drawer's, to which an iron hook is attached, for securing his curcuttee, when climbing. The Gerweggay,—" Cedrela Toona"(?) a tree of the Cedar tribe, is very easily raised from seed—is a rapid grower, and affords good shade for Coffee. The seedlings may be gathered in thousands wherever a tree of the kind exists, and may be transferred to the Nursery until large enough to be planted out. The Howligay is a magnificent tree, and a plentiful supply of seedlings are generally easily procurable, and the same may be said of the Mullee Gergutty, which is of the Ficus class, and is one of the most rapid growers I know, and affords splendid shade. Jack is certainly a magnificient tree ; but as I before remarked, the young seedlings with the seed attached, are liable to entire destruction by monkeys and cattle. In virgin soil, a young Jack will grow up very rapidly, and in three or four years would be 15 or 20 feet high.

In reclamation of old land, however, I have found it is very slow; requiring manure and an immense amount of pampering. The foliage is very dense; but coffee flourishes remarkably well under its shade. Some sort of protection is decidedly necessary, however, for the young seedlings and as the tree is a valuable one it will well repay any little trouble at the commencement. A hedge formed of thorns is a very easy matter, and once the plant is six feet high, it is well able to take care of itself. The best plan for growing Jacks in old land, is to make large holes, which should be well filled up with good soil mixed with manure to within six inches of the surface. Each seedling should be raised in a Bamboo or Wartee basket made for the purpose, and planted with the greatest care, as the slightest injury to the tap-root must be strictly avoided. I am aware that if a Forest be felled, and shade immediately planted; or even allowed to grow up; the growth is sometimes marvellous;—but I have found that after the first three years, circumstances are perfectly changed. I would even venture to say, that four times as long is required to grow trees in old land. If

a clearing in suitable land is made in the open with the pre-determined resolve to allow shade to grow from the beginning; and if a system of clean weeding is adopted, and the soil well dug; seedlings will generally immediately appear in profusion, and in most cases may be relied on to form an adequate shade for coffee; but the operation is one attended with great risk, as it is almost impossible to lay down any definite rules for guidance.

A knowledge of the particular classes of Jungle is indispensably necessary, as in many cases the spontaneous growth, which springs up after the felling, has been found to be of the most useless and unsatisfactory description. In Ghaut Forest, such generally consists of wild Plantains, small Ooprantee and a description of bastard Willow; all of which are utterly useless for shade purposes. In Sholah land and Muttee Scrub bordering on the Ghauts, the subsequent growth is generally thorns, rank grasses, and stunted charcoal: and in the Woodaway class of land it would simply be folly to destroy the primeval forest, which consists chiefly, of all the finest shade trees that can possibly be desired. Sometimes the almost entire clearance of "Bamboo Scrub" and "Coomeree" is necessary, and may generally be carried out with every prospect of success. The removal of such trees as Tarree, Kacki, Booraga, Nellay, Cunnaal, Stunted Nundy, Bulcoonkay, Tersal, &c., is at least advisable, as they are perfectly useless for shade purposes, and in the majority of cases may be considered inimical to success. The subsequent growth on some descriptions of "Bamboo Bungeroo" is remarkably good; but much of course depends on soil, position, and rainfall.

A bleak situation with a heavy rainfall can never be depended upon; and where the Forest trees are covered with moss, and look strained or bent in one direction, all attempts

at clearing, should only be carried out under skilled supervision, and with the greatest caution. A warm steamy atmosphere is necessary for the growth of nearly all the best shade trees, and such is not to be found at high altitudes. There is always a zone, beyond which coffee cannot be grown with success, and in the same manner in regard to shade trees, it will be invariably found that every square mile or so of country has its peculiarities and requirements.

It should be a standard rule, that useless or objectionable trees may always be removed; but that those known to be good for shade, should be scrupulously preserved. It is well to remember, that a young coffee tree, planted in the open, will be unduly forced—will in fact be "hastily run up"—and can never be calculated upon lasting like a tree which has been gradually allowed to develop itself. A heavy crop may be readily obtained without an entire clearance; and as in former years all the failures occurred in the "open," it should be always considered dangerous in the extreme, to adopt any system in the hope that sufficient shade may subsequently be arranged for. Many circumstances may occur to prevent the necessary attention being paid to the planting or rearing of shade in the first season; and the first weeding operation carelessly performed, may entirely remove all prospect of success.

I readily acknowledge that in many cases in clearing inferior classes of jungle, it is very difficult to preserve enough trees for shade; but in all the best lands of the Woodaway type, I am of opinion that with a general knowledge of requirements and the names of the various trees, no difficulty should be experienced. Every undertaking requires care and forethought, and when it is known that future success entirely depends on the manner in which shade is arranged for; the operation of *clearing* surely demands the earnest care of all would-be Coffee Planters. A tree left

can always be removed; but the operation of growing a suitable substitute, will under any circumstances take years to perform.

A tree called the Whotluckee, one of the Acacia tribe, grows wild in the Mulnad of Munzerabad. It closely resembles the Poinciana in appearance, but the foliage is much darker. I have grown this tree from seed in considerable numbers, and have planted it out, and find that Coffee thrives well under its shade.

In regard to the "Charcoal tree," I have found it good to "draw up" young shade, and have used it extensively for that purpose. In the absence of some slight covering, young saplings are apt to get stunted in old land. For coffee, however, I never liked "Charcoal." I consider that it impoverishes the soil, and robs it of its moisture. The light passing through its foliage, has a yellow tint, which is known to have a prejudicial effect on all crop bearing plants. It is also a fact worthy of notice that when a "Charcoal" tree dies *naturally*, a complete circle of coffee perishes also all around it. If the tree however is cut down or "rung" no such loss ensues. Where "Charcoal" has to be removed; it is much better to fell the trees at once, as when green they are easily cut up and removed, and do but little damage in falling. If "ringing" is resorted to, the coffee all around immediately improves, but the "Charcoal" does not fall for perhaps two years; by which time probably a magnificient crop of coffee and new wood has been developed, and the constant annoyance and loss caused by the falling branches, and finally by the tree itself, has only once to be experienced, to be ever remembered. The wood when dry becomes so tough also, that the trouble and expense of clearing away the debris is more than doubled. In open places however, it is frequently found necessary to leave a "Charcoal," and I am aware many Planters consider, that for young coffee, the

shade is good. I always think that even a "Charcoal" is better than nothing; but I am in no way prepared to advocate its use. Unless allowed to grow immediately after the clearing, it rarely lives many years, and is attacked with a species of Borer, which rapidly makes the tree unsightly, and a source of constant annoyance; and ultimately renders its entire removal absolutely necessary; probably just at a time when the coffee is in full crop. It may generally be accepted as a fact, that the first lot of "Charcoal trees" allowed to spring up immediately after clearing, will live 15 years; but if raised on old land, they will generally be found to get the Borer, or become useless from other causes, in about half that time. It is frequently remarked that a fine crop of coffee is obtained after the felling of "Charcoal," and hence is it erroneously argued that it does not rob the soil. I cannot agree to any such proposition, as I have noticed similar results after the removal of all the other classes of tree known to be absolutely pernicious to coffee. The effect noticed is merely owing to the recuperative energy of the soil, the stimulus of light and air, and the increase of hygrometric moisture. The *yellow tinted* light being removed; and the soil relieved of the burden of supporting a greedy consumer of moisture, should alone be considered a satisfactory explanation of the effect on the surrounding coffee.

Castor oil plants have been frequently tried, and I think, I may safely say, that few have experienced any benefit from their use for shade purposes; the digging in of a young crop, before such has lost succulency, is undoubtedly however to be recommended as a manurial operation.

Plantains, Orange and Loquot trees, although ornamental and much prized for their fruit, are not at all suited for shade purposes.

In conclusion therefore, I would strongly advise, that trees really well adapted for shade purposes be selected and

left; and only those that are known to be useless removed. There are so many difficulties connected with the planting and rearing of young trees, that it is at least wise to be provident and cautious. It is always well to remember that years will be required to remedy a mistake, and that in many cases the clearing away of the original jungle trees, has resulted in a hopeless failure. In order to assist as much as possible, I have made a list of some of the trees generally found in Mysore jungles, and have endeavoured to classify them. In the first group will be found those, that are generally considered to be good for shade,—in the second; those that are not to be selected from choice, but from necessity; and in the third,—those that always should be removed, being either useless or absolutely injurious to coffee. I may remark that as a subject of vital importance to all Planters in Mysore, I sincerely hope that others may be induced to publish their views, and give the community the benefit of their experience. For the most part, I shall confine myself to the use of Local or Canarese names; the sound of which I shall endeavour to give in English also. Although I venture to give Botanical names to a few, I cannot vouch for accuracy, as the operation of identification of many local varieties and classes of jungle trees, is a matter calling for the assistance of a skilled Botanist. The lopping, thinning and training of primeval forest trees, constitute an operation of considerable nicety. The axe and curcuttee are the only instruments required, and the coolies must be closely superintended. Parasites and creepers must be carefully removed at the commencement, as well as all drooping branches, and such as would prevent a free current of air passing over the coffee. Too much care cannot possibly be taken in the selection of the trees which are to be allowed to remain. With the assistance of a couple of intelligent and active coolies, a planter has no difficulty in "*marking*" all the trees that are to be removed. The operation is one very easily performed, and is best done with a piece of chalk, which leaves a plain

unmistakeable mark. The great aim must be to endeavour to afford adequate shade and shelter, with the least possible number of trees, and this can only be done quietly and with the use of judgment and forethought. Different aspects demand different treatment—Southern and Eastern faces require the most shade, and Nothern and N. Western the least. Slopes, can almost always be protected laterally; but level fields require the shade to be universally and regularly disposed all over them. In lopping it is well to remember, that old Forest trees generally resent violent treatment, and it is preferable to diminish the *number* of trees, than to endeavour by reckless lopping, to gain the requisite amount of light. I have seen many a stately tree absolutely ruined by excessive lopping, and much prefer to allow the "development of head" to be effected gradually. A fair allowance must of course be made for considerable lateral expansion consequent on the admission of increased light and air; but it is a mistake to think that violent lopping causes expansion of head.

In regard to the amount of shade required, it would be impossible to give any definite suggestions, as such entirely depends on elevation, general situation, and distribution, rather than amount, of rainfall. It is well to remember, that shade is only required for the dry months of the year, and that the distribution of rainfall varies in every Taluk of this Province. I remember a Coorg Planter expressing surprise that Munzerabad with an average rainfall of 80 Inches should require shade at all, seeing that in many places in the "Bamboo" of Coorg, with little more than half that amount, the open system was universally adopted with success. I immediately produced my rain register which I have carefully kept for the past 12 years, and requested my friend to give me a general idea of the distribution of rainfall in the district referred to, and I then found that although the total annual fall was little more than half; that the amount between

January and May, was nearly three times as much as usually fell in Munzerabad during the same period. An excessive rainfall is decidedly not required for coffee. There is a vast difference between what a Planter calls *"growing"* and *"heavy"* weather. It is a fact worthy of notice that early showers in blossoming time, if accompanied with excessive thunder and lightning, and alternated with sunshine, always produce a mature flower; whereas a copious downpour without atmospheric electricity, and accompanied with dull, sunless weather, invariably begets a weak, ill formed blossom. Among the natives it has been particularly noticed that during the last few years the number of Bees has been greatly diminished, and although it would be unreasonable to suggest that their absence has seriously affected the yield ; still it may fairly be said, that the vast swarms which generally appear and await the blossoming, must have a most beneficial effect in the way of fertilizing the flower. I have frequently counted 45 and 50 Hives on a single Forest tree in a Coffee Estate, and when the flower was fully opened every tree appeared well attended by bees.

I merely mention these little facts to show that " a single swallow does not make a summer" and that in regard to coffee culture generally, that it is a number of little things aggregated together that constitutes success,—some are controllable by man, and others are not, and it therefore devolves on every Planter, to make his arrangements to suit the ordinary exigencies of local requirements.

In conclusion I would wish clearly to impress upon all who may pay me the compliment of reading these remarks, and the annexed lists of trees suitable and useless for shade purposes, that the subject generally is well worthy of mature consideration, and I trust that before *removing* a single tree either good, bad, or indifferent, that due and careful

inquiry may be made. It is frequently necessary to leave trees which are next door to useless, simply on account of there being nothing better available, and I hope I have already fully explained the danger of going to work with any *rigid* rule for guidance.

All must be done quietly and with the greatest caution; and it behoves all interested in coffee to make an "experience" for themselves before being led by that of any other single individual. Inquiry, always gives a little trouble; but the reward does come—and like a landscape when viewed from different positions it presents at each fresh glance some new pleasure and enjoyment hitherto unnoticed. I have made these remarks as I have frequently met men anxious for information—fond of living at high pressure; and prepared to act upon any new suggestion without a moment's reflection. Each man should learn the requirements and peculiarities of his Estate, should first carefully consider all reasonable probabilities connected with any work to be executed, and then after having collected all available hints and information, should commence methodically to carry out the desired operation,—always remembering, that a tree once felled cannot be quickly compensated for, and that at least, in many portions of Mysore, even an inferior tree is better than nothing at all. All works in coffee culture should be *systematically* considered but *methodically* executed.

LIST I.

List of Indigenous Trees which are generally considered to be well suited for Shade purposes.

Local Name.	Remarks.
Hulsen ಹಲಸಿನ ಮರ.	The Jack.—"Artocarpus Integrifolia." Excellent and dense shade. 2 varieties. "*Billarn*" (ಬಿಳಾನು) bearing soft-tasteless fruit, timber loose and some what brittle. "*Buckee*" (ಬಕ್ಕೆ ಮರ)—fruit lucious; timber good for building purposes—yet brittle and cross grained; used for rough furniture.
Hessan ಹೆಸಾಣ ಮರ.	"Artocarpus Hirsuta." Original tree good for shade and strongly to be recommended—but shoots from stumps should never be encouraged or depended upon as they generally die and fall down about the 10th year. Timber excellent for building.
Cub Busree ಕಬಸರಿ	"Ficus Tuberculata." Excellent shade—Immense almost horizontal branches. Propagated by cuttings. Timber loose-grained; useful only for the roughest purposes.
Billee Busree ಬಿಳಿ ಬಸರಿ ಮರ	A whitest barked tree of the same class, affords cool, but light shade. Propagated by cuttings.
Gonee ಗೋಣಿ	Leaves larger—Excellent shade and affords an immense amount of leaf and fruit manure. Propagated by cuttings—Timber open grained, but used for rough planks.

Hunnarl Busree
ಹನಾಲ್ ಬಸರಿ

A magnificient shade tree—Very lofty—leaves large, like those of the Wartee.—Shade cool and excellent for coffee—Ficus tribe.

Aldoo
ಆಲುದ ಮರ

"Ficus Indica." First class shade, but is entirely bare for about one month in the year. Propagated by cuttings; wood said to be durable under water, but is loose grained—Aerial roots strong—used for yokes and tent poles.

Mullee Gerguttee
ಮಲೆ ಗರಗತ್ತಿ

Grows to an enormous size and has large buttress like roots. Foliage dense and shade excellent. Timber loose, easily split, but useless except for the roughest purposes. Quite different from the small Gerguttee which is injurious to coffee.

Bomarlee
ಬಮ್ಮಾಲೀ

Another enormous tree, with dark evergreen foliage—Timber good for planks but not for rafters or beams, as such are greedily devoured by a species of Borer.

Gerweggay
ಗರುವಲೀಗೆ

Cedar tribe (Probably "Cedrela Toona") There are (2) sorts

(1) Cul Gerweggay (ಕಲ್ಲು ಗರುವಲಿಗೆ) very dense shade—Timber hard and excellent for building purposes.

(2) Gund Gerweggay—(ಗಂಡು ಗರುವಲಿಗೆ) also called Chitkye (ಚಿಟ್ಟ ಕಾಯಿ) Card Bayew (ಕಾಡು ಬೇವು) and Nogwara (ನೊಗವಾರ) shade light and sufficient, raised from seed. Timber light, durable, and easily worked. It is called Nogwara from Nogga (ನೊಗಾ) a yoke,

being par excellence the best wood for making such.—Good also for rough furniture.

Howligay ಹಾವಳೀಗ — Supposed to be the "Acrocarpus Flaxinifolius"—one of the most lofty and elegant trees in the Forest—affords excellent shade, and is propagated by seedlings which can be found in profusion. Timber light and straight grained, used for Shingles.

Davegherry ದೇವಿಗೆರ — Cedar tribe—a beautiful dark foliaged tree—Magnificent timber, being in fact a white aromatic cedar; useful for all purposes, being close grained, susceptible of taking a polish, and durable; suitable for turning—and ornamental work.

Wartee ವಾಟೀ — A handsome tree with glistening large leaves—affords good shade; is deciduous, but rapidly regains its foliage. Gives an immense amount of leaf manure—Timber, yellow, hard, durable and easily worked.

Googla. ಗುಗ್ಗಳ — "Amyris Commiphora." A Gum tree-yields an inflammable strong scented gum used as incense in temples. A stately tree affording good and lofty shade. The kernels of the large blue seeds are edible—Timber very hard and cross grained, but not durable under exposure, and only used for planks.

Bockle ಬಕುಳ — Probably "Mimusops Elengi" celebrated for the beauty of its foliage and white jessamin—like flowers, Timber heavy

	and very durable, and not attacked by white ants.
Culdwal ಕಲ್ದುವಾಲ್	A handsome, but very densely foliaged, tree. Leaves large and thick; timber very hard, cross grained, and extremely difficult to work, and will not stand damp or exposure.
Hesseroogunny ಹೆಸರು ಗಣೆ	A good shade tree and one that can be easily trained to a head. Seedlings always to be found in profusion—Timber soft and very brittle—should never be used or trusted for beams, as such are apt to break off short; may be used for planks.
Quoretty ಕೊರಟಿ	Very similar to the above, but grows to an enormous tree—shade moderate—Timber used for planks; but will not stand damp or exposure.
Marveen ಮಾವಿನ ಮರ	"Mangifera Indica"—Mango—A stately—dark foliaged tree too well known to require description. Timber used for planks, door frames &c., for stores, and out houses.
	Heart wood of very large trees, used for Rafters.
Cool Marveen ಕೊಳ್ಳು ಮಾವೀನ್	Quite a different class of tree—Foliage thick and affords good cool shade—Timber good for general building purposes; but is light and easily worked—used for cases.
Gobra Nairul ಗೊಬರ ನೆರಲು	The best of the Nairul tribe for shade. Coffee flourishes under it—wood very soft—red and spongy—splits in drying

—used for rough purposes and making pounding poles, &c.

Harlmuddy
ಹಾಲ್ಮಡಿ

Affords a nice light, shade—rapid grower—yields a fragrant gum used as incense—Timber extremely light and good—principally used for planks—cases &c.

Murragud
ಮರಗದು
ಕರ್ಕಿ
ಅಕ್ಕವ

Also called Curkay or Acquar. This tree affords very dense shade and has hitherto been preserved. It is always to be found in the "woodaway" type of Jungle. It is however objected to, on account of the immense amount of surface feeding roots which form an impenetrable net work entirely preventing digging. In process of time old coffee does suffer—both from these roots and from want of culture; but as a lateral shader there could not be a finer tree.

The timber is used for beams, but seldom for rafters—being very hard and cross grained and liable to attack of White-ants. Not used for firewood, as during combustion, it emits a profusion of sparks which cause dreadful skin irritation, puffed eye-lids and dropsical looking faces.

Puttra Jargee
ಪತ್ರ ಜಾಜಿ

A magnificent tree when grown in the Jungle—affords excellent shade—but is seldom met with; only one or two trees being found in a large jungle.

NOTE.—The trees of the Ghaut forests are specially omitted—being more valued for their timber than for their shade—Trees are often known by different names in different Talooks. The distinctions drawn may be erroneous, and it is well to consider such as purely local, and in no way Botanically correct.

My readers will readily understand that among a primitive and uneducated class like the inhabitants of the Mulnaad of Mysore, that the names of trees although generally known and studiously respected, can in no way be accepted as expressing any actual generic distinction, concerning which the natives know little or nothing.

In explanation I will merely give one example.

Hulsoo or Hulsen Murra is the Jack.

Hulsen Hunnoo is Jack Fruit.

Feringhee Hulsen Hunnoo is the Pine Apple.

The sound of Canarese words is also very misleading thus.

Goorcul (ಗೊರಕಲ್) is the Charcoal Tree.

Gooracul (ಗೂರಕಲ್) is the Coffee Weed.

Goreecole (ಗೊರೀಕೊಲ್) means a Torch.

Gorecul (ಗೊರಕಲ್ಲು) means Quartz.

again

Ullee Murra (ಅಳ್ಳಿ ಮರ) is the Peepul Tree.

Ullalee Murra (ಅಳಲೇ ಮರ) a tree bearing Gall Nuts.

Ullee (ಅಳ್ಳಿ) means teased cotton.

LIST II.

Indigenous Trees—generally found in Coffee Jungles which may be styled suitable for shade in a lesser degree than those in List I—and which should be left from necessity but not from choice.

Local Name.	Remarks.
Sedlay ಸಡ್ಲೆ ಮರ	There are two varieties. (1) Cul Sedlay (ಕಲ್ಸಡ್ಲೆ) (2) Bungar Sedlay (ಬಂಗಾರ ಸಡ್ಲೆ) The former is generally found outside the Jungle--Timber extremely hard. The latter has dense foliage ; leaves subject to attacks of a fungus closely resembling Hemileia. Timber useless—except for making native ploughs—Makes good charcoal.
Gwoddan ಗೊದಣ ಮರ	"Spondias Mangifera." Three varieties. (1) Gwoddan (ಗೊದಣ) (2) Each Gwodda (ಈಚ ಗೊದ) (3) Umtee Gwoddan (ಅಮಟೆ ಗೊದ) The Gwoddan is a very large deciduous tree—gets new foliage however rapidly—large fruit like Loquots eaten by deer and pigs—which falling damages coffee—however coffee under its shade always bears heavily. Timber soft and useless except for rough planks. Umtee fruit used for pickle. Gwoddan fruits not edible.
Ultwall ಅರಟವಾಳ	Soap nut "Sapindus Emarginatus." Various opinions are entertained about the suitability of this tree for shade.

Coffee sometimes appears to suffer in immediate proximity; but no actual injurious effect can be said to result—The shade afforded is styled "hot" and indifferent, being too dense in the Monsoon. The fruit falls in immense quantities and attracts myriads of peculiar red beetles; which have been noticed also to eat the leaves of the coffee tree—Timber used for rough beams—cross-grained.

Tettagherry
ತಟ್ಟ ಗರ

Deciduous—immense leaves attacked by a Black Fungus allied to Hemileia—affords a dense shade at certain seasons. but not when such is most required Coffee always bears heavily under it, but sometimes suffers when in immediate proximity—Sap is similar to juice of the marking nut and if applied to the skin, causes *ulcers* and discoloration. It is well not to stand near when the axe is being used.—Produces an immense amount of leaf manure—but such decomposes very slowly—Timber used for yokes—soft and light.

Nairul
ನೇರಳ

Four varieties.

(1) Nairul. "Barringtonia acutangula." (?)

(2) Jum Nairul (perhaps "Syzygium Jambolana.")

(3) Pun Nairul (Rose Apple.)

(4) Gobra Nairul.

The common Nairul found in the Wodaway type of land is frequently a stately tree—affords moderate shade, Leaves suffer from Black fungus. Timber

hard and used in building, but is subject to attacks of a very large Borer,

Jum Nairul producing large plum like fruit, which is edible ; generally grows on the margin of Jungles, but seldom inside. The Rose Apple tree is not to be recommended for shade—but is not injurious, and is when young and well trained, very ornamental.

Nundy
ನಂದಿ

Benteak—Is a white barked tree—yielding but poor shade. It grows to an immense size in good forest, and all around such trees coffee bears very heavily—when young, or growing in inferior jungle and of small size, Nundy may be said to be worthless for shade —though it is certainly better than nothing. Large trees should always be preserved unless required for timber—which considered generally may be classed excellent for all purposes—being strong—nicely grained and easy to work.

Kenjaree
ಕೆಂಜೇರಿ

ಬಟ್ ಕೆಂಜೇರಿ

2 Varieties.

(1) Kenjaree—Timber very hard.

(2) But Kenjaree—Timber soft and useless.

Not recommended for shade, but is a tree which grows generally in groups and has sometimes to be left. Leaves take an extremely long time to decay—even after burial for a year they retain their form—may be styled a "hot" tree—When dead, or dying, a circle of coffee frequently dies also—

This tree will not stand severe lopping and is difficult to train to a head. Timber extremely hard—ruins several axe generally—used for posts in building.

Harl Bundigay
ಹಾಲ್ ಬಂದಿಗೆ

Affords indifferent shade—may be styled, a "hot" tree, that is, does not, however thick, afford a cool shade. Leaves if rubbed smell like sweet briar—always has a profusion of suckers—after lopping requires constant trimming—Timber resembles Lignum Vitæ—very hard, heavy and durable—not touched by white ants—useful for posts and beams; particularly serviceable for bed for plates for machinery or sleepers, also chisel handles.

Billi Gercul (ಬಿಳಿ ಗರಕಲ್)
Cul Gercul (ಕಲ್ಲು ಗರಕಲ್)
Cuddee Gercul (ಕಡೆ ಗರಕಲ್)

affords indifferent shade—very brittle and does not stand wind. Timber useless.

Sumpigay
ಸಂಪಿಗೆ

"Michelia Champaca"

There are three varieties.

(1) Woodaway Sumpigay (ವುಡ್ವೆ ಸಂಪಿಗೆ)
(2) Hunnarl Sumpigay (ಹನಾಲ್ ಸಂಪಿಗೆ)
(3) Narg Sumpigay (ನಾಗ ಸಂಪಿಗೆ)
"Mesua Ferrea."

The latter is a small tree grown for its highly scented flowers.

None of this class are recommended for shade, but may be used for belts or lateral protection. Under very large trees coffee is always poor and frequently actually dies out. The Sumpigay attains an immense size, sometimes

measuring 18 feet in circumference—yields excellent timber—which takes a good polish and is easily worked.

Hunyellay
ಹಂಣು ಯಾಲೆ

Also called Nye Toopra (ನಾಯಿತೂಪರ) which may be a different variety. Affords a fair shade—but is frequently found prejudical to coffee—may be left in the absence of a better class.

Timber useless, except for the roughest planks.

Harlay
ಹಾಲೆ ಮರ

"Minnusops Kanki ;" shade thick at certain seasons, but not cooling—bears an edible fruit full of a very sticky white milk, said to have Anthelmintic properties.

Timber—Softish—might be used for rafters for out houses.

Japle
ಜೆಪಲ್ ಮರ

Two varieties.

(1) Adikay Japle (ಅಡಿಕೆ ಜೆಪಲ್)

(2) Mool Japle (ಮುಳ್ಳು ಜೆಪಲ್)

The stem of the latter is protected by enormous spike like thorns, which if cut and allowed to lie about will probably cripple a number of coolies. This tree is useless for shade; but makes excellent charcoal and should always be removed for that purpose—or for posts.

The former variety bears an edible sour fruit—affords ordinary shade.

Timber can be utilized as posts for lines and out houses, but although hard is not durable—excellent for fire wood—easily split.

Woodee
or
Cul Woodee
ವೂದಿ ಮರ
ಕಲ್ಲು ವೂದಿ

A very large rough barked tree with fairly dense foliage—Is a surface feeder and sends out large roots to a distance of 50 yards—When left in virgin soil, coffee will grow up to the very stem and will frequently remain and prosper —but sometimes a complete circle dies out and it is almost impossible to grow vacancies—it is well to remove all Woodee trees before attempting reclamation—Shoots growing from the long roots at a distance are frequently mistaken for young trees—they should be always removed as useless. The wood is perfectly indestructable; sawyers refuse to saw it—It is used for beams and posts—it has a fibrous texture and generally requires half a dozen axes for each large tree, and probably ruins them all.

Choongalee
ಚೂಂಗಳಿ ಮರ

A Deciduous tree—but one producing an immense amount of vegetable manure. Coffee prospers under its shade, though such is indifferent. Timber useless except for rough planks. The dry bark of a felled tree becomes hairy and readily enters the skin causing intolerable irritation and frequently ulcers—If used as firewood those all around are annoyed with an affection considerably worse than "prickly heat"—the whole skin being covered with large blotches which smart, and if scratched; frequently turn into open sores.

Chendwalla
ಚೆಂದ ವಾಲ

Has frequently been left—but is a most unmanageable tree being in fact made up of vertical suckers, and is always falling down in pieces, but again shoots up from the bottom.

It is the best tree for making handles for mamoties and axes—being very easily worked and light yet strong—used by Natives to make gun stocks for match—locks.

Beetee
ಬೀಟೆ

"Dalbergia Latifolia."

This tree is but an indifferent shader. It remains for a long time without any leaves at all. It is the Black wood, so called, of Southern India—Timber is strong, very durable—yet brittle—used for ornamental carving, and where plentiful, for building, for which it is admirably suited.

Honay
ಹೊಂನೆ

"Plerocarpus Marsupium" affords anything but satisfactory shade—but is sometimes left. Timber excellent but is cross grained. This tree produces the gum kino, and the sap if mixed with oil is said to be good for certain skin diseases—although the timber is a light brown—if white washed, it becomes a very dirty yellow color and discolors the wall or plaster.

Muttee
ಮತ್ತಿ

"Terminalia Coriacea"?

Is not recommended being a great lime feeder—and affords a most indifferent protection for coffee—Timber extremely hard and durable, but difficult to work being generally used for beams,

posts, &c., Natives burn this tree and manufacture eating chunam or lime —which is said to be extremely pungent.

Cuppra
ಕಪರ

Opinions again vary. Any way it is not to be recommended. In two cases out of five the coffee appeared to have died out all around. Certainly should be removed previous to attempting vacancy planting.

Timber used for Reepers, being soft yet durable and not requiring any holes to be bored.

Hemmuddy
ಹೆಂಮುಡ್ಡ

2 varieties

(1) Hemmuddy (ಹೆಂಮುಡ್ಡ)

(2) Yerlyellay Hemmuraga (ಏಳು ಯೆಲೆ ಹೆಂಮುರಗ.

The former is the large tree and affords ordinary shade—but is said to be "hot."

Excellent planks are made from this tree which yields the lightest timber possible—well suited for making cases.

Coolee
ಕೂಳಿ

Large leaves—shade decidedly indifferent —yet coffee flourishes under it. Very often grows in groups and consequently has to be left in clearing. Timber hard, close grained—but will not stand the slighest exposure. Used for beams —and for making the body of large Native Drums.

Tor Hulsoo
ತೊರ ಹಲಸು

Affords a very dense shade—which is not cooling—Is a surface feeder and coffee does not flourish under it. Tim-

ber soft and readily split—used for beams and reepers. Makes excellent charcoal and torches.

Putgah
ಪತಗದ ಮರ

Also Cul Putgah; in appearance similiar to Gercul—but a darker tree yielding a fair shade and an immense amount of leaf manure—Is deciduous, but rapidly becomes green again; when cut or felled produces a most intolerable stench. Timber hard, heavy, but not used.

Ubble
ಅಬಲ್

Shade adequate and no bad effects known. Timber used for rough posts and fuel —makes good charcoal and torches.

Bayen
ಬೇವಿನ ಮರ

" Azadarachta Indica" the Neem Tree. The real Neem tree from which oil is produced—Margosa—is called in Canarese *Kirree* Bayoo (ಕಿರಿ ಬೇವು) but there is another diminutive tree called *Kurree* Bayoo (ಕರಿ ಬೇವಿನ) and yet another large tree styled Heb Bayoo—The real Bayoo is good for shade and although very seldom met with in the Malnad has been found well suited to coffee—Wood is fibrous and reddish brown in color—used for carved pillars and door panels—The Heb Bayoo is met with all over the Maidan, but seldom in the Mulnaad. Used much in house building. The leaves of *Kirree* Bayoo are bitter and used for killing moths—whereas those of the shrub Kurree Bayoo are pungent and used as a condiment.

Cowdeyal ಕವಡಿಯಲ್ ಮರ	Not recommended—but better than nothing—Timber extremely loose and open—useless except for making slabs on which with the aid of powdered quartz to sharpen pruning knives and other edged tools, for which purpose it is well suited.
Uccra ಅಕರಾ	Shade—ordinary—bears a fruit like a sparrow's egg and is generally found in poor jungle ; wood somewhat hard and used for pounders.
Cuddarn ಕಡಾರ್ಣ ಮರ	Generally found only in outskirts. Timber hard and red ; said to be durable as beams.
Goorcul ಗೂರಕಲ್ ಮರ	The Charcoal tree "Sponia Wightii"—a tree of secondary growth—foliage very light and giving a yellowish green tinted light—previously described and not recommended, though better than nothing.
	Wood useless except for making yokes and rafts. Sometimes used for rough sheds and wlll last a number of years if not exposed, and with plenty of smoke.
Rarmraikee ರಾಂರಡಿಕೆ ಮರ	Very like the Culdwall in appearance—affords fair shade. Timber cross grained—readily eaten by white ants.
Quarn Tolden ಕೋಣನತರಡಿನ ಮರ	Deciduous—and although bare for a long time—the coffee appears to flourish under it—bears a large red hollow pericarp—which when dry splits up and throws out the seeds.

	Timber useless except for very rough purposes.
Neergennee ನಿರಜೆಂನೆ	A small tree not generally found in primeval jungle—but always in reclamation—shade indifferent. Used by natives to make pounding poles and handles for tools.
Whatluckee ಹೊಟ್ ಲಕ್ಕಿ	An Acacia—Can be raised from seed; probably " Guazuma Tormentosa."
Whongie ಹೊಂಗೆ	Wood light, tough, and fibrous; oil expressed from seeds, The oil cake makes excellent manure for coffee, Rarely found *in* the jungle—being generally near streams, and on the open flats. Shade appears good—being very cool. This tree deserves a trial, but has not been tried for coffee; or at least the effect has not been properly noticed. Its wood, is used by stone cutters for making solid cart wheels. It makes excellent charcoal—Leaves used for manure by natives.

LIST III.

Trees generally considered to be prejudicial to coffee, and certainly entirely unfitted for shade purposes.

Local Name.	Remarks.
Kaki. ಕಕ್ಕೆ	Supposed to be "Cathartocarpus Fistula" Whitesh bark and long pipe like pods containing the seeds. Timber reddish and hard, might be used for rough beams.
Bulcoonkay ಬಲ್ಕುಣಿಕೆ	Generally has a fluted stem. Timber hard and very rough—but is never used by Natives who style it Juglagunti (ಜಗಳಗಂಟಿ) and hold a superstition that if used in house building, that there will be incessant quarrelling among the inmates.
Tersul ತಡಸಲ್ ಮರ	Fibrous, tough, and hard to work—used for beams and posts
Nellee ನೆಲ್ಲಿ ಮರ	"Phyllanthus Emblica," Fruit like a large gooseberry—said be good for quenching thirst—although very sour water tastes extremely sweet if drunk immediately after biting or chewing the fruit; which is also used for making pickles Wood used for fuel. Fruit very destructive to crabs, snails &c.
Booragah ಬೂರಗ	"Bombax Heptaphyllum" 2 varieties (1) Booraga (2) Mool Booraga

	Timber soft and spongy—used for making cases—
Hunnarl Taree and Taree ತಾರೆ ಮರ ಹನಾಲ್ತಾರೆ	"Terminalia belerica." Has sometimes been left for shade, but is utterly useless, having no leaves for the greater part of the hot weather.
Cunnagal ಕಣಗಲ್ ಮರ ಬೆಟ್ಟ ಕಣಗಲ್	2 Varieties (1) Cunnagal (2) Bet. Cunnagal Produces a highly scented flower—Wood used for making native drums.
Shargadee ಶಾಗಡೀಮರ	Probably Schleichera Trijuga timber very heavy—tough and extremely durable—very difficult to work—used for bed plates—and also for oil and sugar presses &c., Branches make excellent charcoal
Chuppul ಚಪಲ್ ಮರ	Also called Oortalee (ಉಡತಲ್) suitable for rough posts—is cross grained and difficult to work.
Marglee ಮಾಗಳೀ	2 varieties (1) Marglee (2) Sotagud Marglee (ಸೊಟಗದಮಾಗಳೀ) Timber useless except for the manufacture of spoons and ladles—hence the name from Sotaga (ಸೊಟಗಾ) a spoon. Makes excellent torches and charcoal
Benday ಬೆಂಡೆ ಮರ	Timber useless
Bilwara ಬಿಲ್ವಾರ	Probably "Acacia Speciosa" called the "Ryots tree"

	Timber good—very hard and heavy, used for naves of wheels—pestles, mortars, and oil presses.
Whotunghee ಹೊಟ್ಟಂಗೆ ಮರ	Also called Bargai Murra (ಬಾಗೆದ ಮರ) perhaps ("Acacia Elata") doubtful. Timber tough and hard and used for posts, &c, Tree extremely handsome.
Each Gwadda ಯಿಾಜ್‌ಗೋದ	Timber soft yet always remains moist—used for ornamental posts or columns—easily worked and durable.
Yeliagah ಯಲಗ	The wild cinnamon Timber softish—but used for yokes, and by natives for sundry rough purposes. If allowed to die naturally, invariably kills a circle of coffee; and if left, some native is certain to remove all the bark for flavoring Hoppers or Native pancakes.
Posee. ಪವ್ರಿಕ ಮರ	A sort of willow—generally grows near streams—Much used for yokes, handles for bill hooks, grass knives &c. being nearly as soft as a piece of turnip when green, and when dry becoming tough and hard.
Gworgie ಗ್ವೊಜೆ	Timber very ponderous, hard and extremely durable—very difficult to cut and adze—exellent for sleepers and bed plates for water wheels or pulpers—used also for beams and posts which remain strong for years.

Hardagah
ಹಾಡಗದ ಮರ

Scented wood—and can be polished. Probably suitable for furniture.

Mootagah
ಮುತ್ತುಗದಮರ

" Butea Frondosa."
Wood only nsed for fuel. Large leaves collected and stored on strings to be utilized as plates for serving food—Beans used instead of condition balls for horses—having authelmintic properties. Red dye manufactured from the flowers used by Natives in the Carman Festival.

Bootarlee
ಬೂತಾಳೆ

A very large tree with orbicular leaves not to be confounded with Bootarlee (ಬೂತಾಳ್) the aloe which should be properly called Cartalee (ಕಾತಾಳ್) or Rarksha (ರಾಕ್ಷಾ). Easily worked; soft wood used by Natives for making idols and large masks—which are subsequently painted in gorgeous colors.

Keechaga
ಕೀಚಕದ ಮರ

Generally found in out-skirts of jungle. Bark profusely covered with thorns. Wood very soft—used by Natives for making pig troughs—bowls &c., and also for rough doors.

Gergutty
ಗರಗತ್ತಿ

(Ficus Asperrima.)
Sand paper tree—leaves used for polishing sandal-wood. Utterly useless for coffee except when young. Large trees always make an entire clearance of the coffee all round them. Wood useless.
Subject to attacks of black fungus which spreads to the coffee beneath.

Hooleechul
ಹುಲ್ಲೀಚಲ್

Generally found in Coomree land and in out skirts of jungle. A tree reserved

	by Government as yielding a red dye of a very inferior kind.
Gowjul or Gowl ಗವುಜಲ್ ಮರ ಗವುಲ್ ಮರ	Wood soft and used to make the stocks of matchlocks and from the bark a fibre is obtained which is used for the slow-match—Generally found in outskirts.
Joomankye ಜುಂಮನ ಮರ	Bark very thorny—wood soft and spongy—fruit when chewed is extremely pungent and causes a copious discharge of saliva; used by Natives for cleansing the tongue after fever—also made into pickle, with wild juniper &c—Wood used by ryots for the shafts of ploughs.
Karri ಕಾರೆ	"Vangueria Spinosa." 2 Sorts. (1) Beld karri (ಬೆಲ್ ಕಾರೆ) (2) Mool karri (ಮುಳ್ಳುಕಾರೆ) The first has small thorns—principally on the branches—Fruit edible when cooked or made into pickle and is smooth and in form an oblate spheroid. The other has large thorns all over the tree—fruit conical—fluted and poisonous being an emetic—very pungent, and used for destroying fish. The Karri is more a straggling bush than a tree and generally only appears in the outskirts of Jungles, but often springs up in reclamation. The wood makes good axe and pickaxe handles and excellent charcoal for iron work.

Whorecky ಹೊರಿಕ್ಕ	A small useless tree—also generally found in Scrub jungle. The wood is of little use except for torches and fuel
Harlwarn ಹಾಲ್ವಾಣದ ಮರ	Jatropha multifida. A thorny tree—deciduous and perfectly useless for shade. Wood very soft, used for making drums, masks and theatrical ornaments and trappings.
Seabee ಶೀಬೆ	"Psidium Pomiferum"—Guava. Generally found only in outskirts; useless for shade and liable to attacks of Bug—Wood tough, light and flexible —easily worked.
Hoonsay ಹುಣಸೆ	Tamarind Tree, Nothing will grow under this tree. Wood, about the most durable known and used for making machinery; very hard and used for all purposes where strength and endurance are required.
Bynee or Buganne ಬಗನೆ ಮರ ಬೈನೆ ಮರ	The Toddy tree. Wood fibrous, very dense and hard, used for pounding poles,—plough shafts,—and many other purposes—Also used for rough rafters & reepers and also as slabs—and for water conduits and tank tubes—The fibrous roots removed, the base of the tree is conical and this piece is fashioned ingeniously into the body of a drum called— Toodãma (ತುಡಮು) which produces a most deafening noise upon being operated on with two leather thongs.—

Hellinghee ಹೆಲ್ಲಿಂಗೆ Ibbenee ಇಬ್ಬನಿ Chollay Kye ಚೊಳ್ಳೆ ಕಾಯಿ	All small and useless trees which will appear, during reclamation and should always be removed. "Cordia myxa."

NOTE. With a few exceptions it will generally be found that trees with glistening foliage are good for shade; whereas those with dull, rough leaves are invariably useless.

LIST IV.

Trees which can be readily propagated and are valuable for reclamation purposes.

Local Names.	Remarks.
Uttay ಅತ್ತಿ	(Ficus Glomerata.) As before remarked this tree is *par excellence* the very best shade tree known, and should always be selected in preference to any other. It seldom exists in primeval forest—being a tree of secondary growth. It is almost destitute of leaves during the Monsoon but in the hot weather is clothed in rich glistening foliage. It is therefore admirably suited for coffee, which invariably flourishes under its shade, which is of the "coolest" and most desirable nature possible.
Hulsen	Grown from seed.
Busree	Propagated by cuttings.
Gonee	Do do do
Aldoo	Do do do
Pil Aldoo ಬಿಳ್ಳಾಲದ ಮರ	Do do do another of the Ficus tribe which grows into a magnificent tree, but which like the Peepul (Ficus Religiosa) is never found in the original jungle. It closely resembles the Peepul in appearance at a distance and grows very readily from cuttings.
Whotluckee	An Acacia—indigenous to Mysore probably "Guazuma Tormentosa" Grown from seed in Nurseries.

Gerweggay	Already mentioned—most easily grown by digging up and manuring a piece of land on the windward side of a large tree at seeding time. In the Monsoon a profusion of healthy seedlings will be the result.
Mullee Gergutty	Adopt the same measures as for Gerweggay
Howligay	Do do
Mango	Plant seeds in Baskets made for the purpose—as having a very long tap root—successful transplanting is difficult.
Puttarn ಪಟ್ಟಾಣಿ ಮರ	"Cassia Florida" Not recommended, but certainly very easily grown from the seed, and although very liable to be broken by the wind, has been found to be fairly suitable—No actual injurious influence on the Coffee has been noticed. Small seedlings should be used as the tap root rapidly becomes very long.
Soorighee ಸುರಗೀ ಮರ	"Casuarina Muricata." Very useful for the margins of roads and avenues, and although the shade is somewhat "hot" still Coffee frequently comes on very well under it. The seed may be collected by having a large sheet stretched like an awning under the tree; or by small muslin bags tied over the seed cones. The seed should be soaked in cold water for 12 hours and then mixed with some finely pul-

verized *old* manure, scattered on well prepared and shaded beds—A liberal supply of sand should be always used in preparing the beds, and the surface of the soil should be slightly pressed down with a piece of plank before the seed is scattered—this prevents the seed *sinking*. A watering pot with a very *fine* rose must be used.

APPENDIX.

THE RESTING SPORES OF THE POTATO DISEASE.

Extracted from the " Gardener's Chronicle" July 1875.

I now give in conclusion an illustration of the perfectly mature resting-spore of Pernospora infestans, as seen imbedded in the substance of the Potato leaf. These resting-spores, which carry on the winter life of the fungus, are not restricted to the leaves, for I find them sparingly in both haulm and tuber, although I have at present seen the best specimens in the leaves. The engraving given herewith (fig. 19) shows a transverse section through a black spot of one of the leaves from Chiswick, and the resting-spore is seen at A nestling in amongst the cells of the leaf. An antheridium, B, and two oogonia (C. C.,) from which such resting-spores arise, may be seen in the cut, and the old common form of the fungus will be noticed breaking through a hair on the upper surface of the leaf, which is a very uncommon occurrence. The situation of the resting spores can generally be ascertained on the leaves by noticing the slightly thickened and very dark spots, for the bodies are commonly in these spots. It is, however, an extremely doubtful matter either to get them out, or, indeed, to see them when imbedded, for, when mature, they are black-brown in colour, and only a little larger in size than the leaf-cells. These leaf-cells are also intense brown-black in colour from contact with the hurtful mycelium, and almost as hard as wood. The best way to see the resting-spores is to macerate the leaves for several days in water, and then setting them free by crushing the spot between two slips of glass, The presence of the fungus in the leaf makes the cells very thick and woody as well as black, so that in crushing the leaf cells the resting-spore is not uncommonly

crushed at the same time. With care, however, they can be got at, when they will be seen, as at D, covered with warts or coarse reticulations, and beautifully regular and perfect in outline: when young they are of a pure warm sienna colour, and when perfectly mature, brown-black and shining. They are sphærical or slightly egg-shaped, and measure on an average about one-thousandth of an inch in diameter. I consider it worthy of special note that these resting-spores are almost exactly the same in size, conformation and colour with Peronospora arenariæ, Berk., an allied species found parasitic on Arenaria trinervis. In looking for these bodies care must be taken not to confound them with corroded cells, granules of starch injured by the disease, or foreign bodies.

At E is shown a semi-mature resting-spore with pollinodium attached, accidentally half washed out of its coating of cellulose by maceration in water.

I may say as an addendum that to me there is a marked analogy in size and habit on the one hand between the oogonia and the swarm-spores, and on the other hand between the simple-spores and the antheridia. I consider that the oogonia and antheridia are merely the intercellular condition of the swarm-spores and conidia, which latter are the aerial state of the former.

The facts which point in the direction just indicated are these :—Sometimes there is no differentiation in the contents of the swarm-spores, but the plasma is discharged in one mass and not in the zoospore condition, the swarm-spore then resembles the oogonium. At other times the oogonium shows a distinct differentiation in its contents, and matures from one to three resting-spores, which to me shows an approach to the condition of the swarm-spore. *Worthington G. Smith, Milway Grove.*

THE RESTING SPORES OF THE POTATO DISEASE.

(CONTINUED.)

As I have now had the fungus which causes the Potato disease under close observation for the past seven weeks, I send you some of the most noteworthy facts which have more recently attracted my attention.

1. The plants sent to the Royal Horticultural Society by Mr. Dean on July 21, were covered with the Peronospora far beyond anything I had ever seen before. The haulm, the leaves (on both sides alike), and the berries, were covered. Some of these plants, after being placed on a garden bed, and covered with leaves (to keep them moist), were the next day one white mass with the Peronospora.

2. The Potato fungus (as commonly seen) bears a far larger number of simple spores than inflated vesicles containing the zoospores or swarm-spores, but in Mr. Dean's plants the fungus produced zoospores almost exclusively, and in the greatest abundance. As the zoospore is a higher development of the plant than the simple-spore, this latter observation points to the unusually robust health of the fungus this season.

3. On suspending the infected leaves over a glass of water for from twelve to seventy-two hours, the swarm-spores fell in abundance (either free or in the vesicle) on to the water, and there germinated. No single drop of the water could be taken up for examination without meeting with the germinating spores, the threads radiating over the water in every direction, evidently in quite a congenial element. It brought the following fact to light, which is of importance—some of the vesicles which usually discharge the swarm-spores discharged instead a thick mass of mycelium; and this cord, when it had proceeded a considerable distance over the water, there had its contents diffe-

rentiated in a necklace-like manner, and gave birth to the zoospores far removed from the original vesicles. The same thread also produced two true oogonia on the water.

4. In your last report of the meeting of the Scientific Committee (p. 113, middle column), under Saprolegnia, you say Mr. Renny showed a species of Saprolegnia which might be mistaken for the spores (meaning oogonia) of Peronospora. But if reference is made to my original paper it will be seen from the first that I have perceived the intimate connection between the new condition of the Potato fungus and the Saprolegnieæ. On my side I have the high authority of Thuret and Berkeley for similar alteration in the diseases of silkworms, flies, &c. I am quite prepared, therefore, to consider Mr. Renny's plant the same, or some close ally, with mine, even if it should turn out to be a true Pythium, and its oogonia produce zoospores in water, especially after what is known of the nature of Cystopus, the close ally of Peronospora. Two strong points in favour of this view are these:—(1.) The resting-spores of Pythium, are *unknown*, but if I find Pythium inside potato stems and leaves mixed up with the Peronospora, and the same Pythium in the very centre of the tuber of the potato (as I have done), there maturing itself and forming its resting-spore, then the identity of the two may reasonably be assumed, and the resting-spore of the Pythium, as well as the Peronospora, is found. (2) The same cells in the Saprolegnieæ will alternately produce, under the same (or diffirent) conditions, zoospores or resting spores, therefore, if zoospores are produced in Mr. Renny's oogonia in water, it is reasonable to assume that under different conditions resting-spores would be formed by similar cells. I have, from the first, believed the Saprolegnia condition of the fungus to be widely diffused, and when in that state it quite possibly grows on diverse plants and substances in watery places, as you well explained the subject last week. The Saprolegnia is the caterpillar condition (belonging to the water,

like the larva of the dragon-fly), the Peronospora somewhat analogous with the perfect butterfly, and the resting-spore with the chrysalis.

5. I find by experiment, when badly diseased haulm and fruit is partly submerged for from one to four days, the Peronospora changes its character, and produces the Pythium or Saprolegnia-like growth on the submerged parts. On examination of the plants this may be easily overlooked, as the Saprolegnia commonly frees itself and floats on the surface of the water, and must be carefully taken off (invisible as it is) with a camel-hair pencil. If the oogonia now produce zoospores in the water, as in Pythium, which is possible and even probable, it in no way invalidates my views, or makes the connection less probable between a true Pythium and the Peronospora.

6. The aerial spores of the Peronospora never become globular in water, whilst the oogonia and antheridia are always so.

7. A superabundance of water excites the growth of the mycelium, but it retards the proper production of the resting-spore, just as a superabundance of water in most plants makes leaves and retards flowers.

8. In my calendar of the weather I find we had here only five wet days from May 7 to June 10 (no wet between May 8 and 20), and it was during this dry weather that the potato fungus this year lived inside, and at the entire expense of the plant, and there perfected its resting-spores. With the twenty-two wet days after June 10 the Peronospora put on its usual shape, and came to the surface.

9. I have got my most abundant materials from the tuber when soft and almost transparent, like painter's size; in this state the starch is utterly destroyed, and, what is most curious, there is no offensive smell. The tuber fre-

quently decomposes with a horrible fœtor, and turns whitish inside ; the starch is then all present and not much injured, and a very little indeed can be seen of the fungus.

10. The season is too far advanced, and the fungus has already caused too much destruction, to think of grappling with it this season, but when it is remembered how the Vine and Hollyhock parasites have been restrained, it certainly does not seem impossible that means may be found to mitigate the damage done every year by the Potato murrain. *Worthington G. Smith.*

Extract from the "Gardener's Chronicle" July 1875.

The doubt we expressed as to the identity of the new phase of the Potato disease with the "curl" is confirmed by the conflicting statements made by those who speak of the curl from personal recollection. It is quite clear that different people have very different notions, not only as to what the curl is, but also as to what the ordinary potato murrain is. We have received samples from various persons, and we have lately had the opportunity both in Scotland and in England of seeing various patches of more or less diseased Potatoes. Some of these have been pointed out to us as affected with "curl," others as with "the disease," others as attacked with wireworm, and so on. In the case of the ordinary potato disease, most people are unfortunately so familiar with it that the misapprehensions of the few are of little relative consequence. In the case of the disease principally affecting the varieties of American origin the matter is different, and it is very desirable that people should not jump at conclusions before they really know whether the disease they are talking or writing about is really the same as that which was first observed in the Chiswick Garden. Fully half of the specimens sent to us, or that we have had pointed out to us in the country, as affected with the "new" disease, were really the subjects of

some disease or morbid condition quite different in outward aspect to that which we first saw by the sea in Kent, subquently at Chiswick, afterwards in various localities in England, and within the last few days in the south-west of Scotland. For our own parts we must still doubt the identity of the so-called new disease with "curl," as the appearances presented do not tally with the printed descriptions of that malady; while, as we have stated, the oral statements of those who were personally familiar with it are very conflicting. If these potatos of American extraction be really affected with "curl," then the discovery of the Potato fungus in its various stages in them is of the more interest, as it shows that it must have been in the country in the old "curl" days, long before the murrain was heard of. Meantime, as some of our correspondents to whom scientific terms are not familiar, and who are not accustomed to the study of microscopic fungi, are doubtful as to what Mr. Smith really has done, we will endeavour to put the matter into plainer language, though at the risk of sacrificing strict accuracy to clearness. The spawn of the Potato fungus permeates tuber, haulm, and leaf in the form of extremely fine whitish threads. Through the pores of the leaves it sends up branches bearing buds of two different kinds—the one sort arranged in little joints, which separate, fall off, and grow, the other sort consisting of egg-shaped cases containing minute spores, which, when they escape from the burst case, move about in the way once supposed to be exclusively confined to the animal kingdom —hence the name "zoospore." These zoospores cease their vagrant habits in a little while, and they too, grow. So far then we have the Potato fungus propagated by two sorts of buds, which become detached, and reproduce the fungus just as the bulbils of the Tiger Lily grow into a new plant. But in addition to these—which we liken to buds because, unlike seeds, they are not the result of reciprocal sexual agency—there are in some fungi, probably in all true sexual organs analogous to the stamens and pistil

of flowering plants. Now, these sexual organs were known to exist in fungi closely allied to the Potato fungus, but they had not been clearly seen in that particular species till Mr. Smith had the good fortune to discover them the other day. Montague and Berkeley had both been on the right track, but it was Worthington Smith who successfully solved the mystery.

The import of this discovery will strike every one, although the practical results may not be immediate. Many plants, even among the higher plants, exist in several stages, just as an insect passes through several stages before it emerges as a full-fledged butterfly. It is one of these stages —and that the sexual stage—that Mr. Smith has discovered in the Potato fungus. We still lack the knowledge what are the conditions which induce this particular stage of existence. We are still without explanation of the fact of its occurence mainly in American varieties, or whether it be, which is hardly likely, confined to them. We know in the case of the Bee Orchis, for instance, that the plant may go for years without flowering, and then all on a sudden the flower-stalk is thrown up. But we do not know what circumstances bring about this result, any more than we do in the case of the Potato fungus. Is this sexual stage just discovered by Mr. Smith really of very rare occurrence, or does it occur frequently? Again, what circumstances favour it—which are prejudicial?

Answers to these inquiries must be forth-coming ere the discovery is likely to be of immediate practical benefit. Meantime, as there is no cure for an unknown disease—*ignoti nulla est curatio morbi*—so we may hope that now the disease is better known, if cure be not possible, prevention may be.

Extract—continued.

Unfortunately, with the new light thrown on the life-history and the resting-spores of the Potato disease by the valuable experiments of Mr. Worthington Smith, so lucidly illustrated and described by that gentleman in your pages as to lay us all under the deepest obligation to him, the Potato disease has again broken out with a spontaneity and an energy beyond precedent. It can hardly be said to have come unexpectedly. The Potato crop, up till now, has been one of unusual promise. The recent rains, however, have produced an extraordinary length and succulency of stem. Both these were sources of danger. All, however, generally promised well until within the last two or three weeks. The early crops somewhat more watery than usual, were a beautiful yield and of fair quality, The late ones made unusual progress alike above and below. Such strong growers as the Climax, Late Rose, Sutton's flour-ball, Red Regents, Flukes, &c., were all simply magnificent. But the heavy rains and semi-saturated atmosphere and soil, combined with the soft succulent growth of the Potato plants, have at length originated the disease almost everywhere, and it is spreading with more than usual rapidity. Its fatal effects are seen running in black lines and patches through almost every garden and field, and the unwholesome odour of diseased Potatoes is wafted abroad on almost every breeze. The resting-spores now proved by Mr. Smith's experiments and observations to be always present, have been stimulated into active life by climatal and vital conditions most favourable to their development, and have made haste to possess the Potato plant and its produce, and lay both low in rottenness.

Can anything be done to arrest its progress or save the crops, so plentiful and fine, from destruction? Such has been the sorrowful query asked hundreds of times during the past weeks, as I have examined scores of cottagers' gardens well stocked with fine crops of doomed

Potatos. Mr. Smith's discoveries, by enlarging our knowledge, may ultimately supply an answer; but at present they seem to make the enemy more powerful by showing that it is always lurking near, ready to strike when conditions of earth, air, and plants are most favourable. It also shows the Peronospora more powerful, by revealing its threefold or more modes of reproduction. Destructible in some states it seems positively ubiquitous and invulnerable in others. For the present it almost seems as if the Peronospora had completely over-matched our skill to destroy it. We know better what it is, and also seem more unable to cope with it. Meanwhile, in its more common and well known form, it is sweeping down our crops by wholesale, and converting thousands of tons of wholesome food into loathsome rottenness.

As we cannot arrest the destructive force of this disease, may we not save something by lifting the Potato crop at once? This is what I have advocated for years, and each season's experience proves it the best method of saving part of the crop. Left in the soil with the tops either on or off destruction mostly runs through to the bitter end; lifted as soon as the disease is seen on the leaf, and before it has time to reach the tubers, the major portion of the crop may be saved. I know the stock objections that have been raised, such as a loss of weight, of flavour, and also losses from disease. As to the two first, is it not better to lose some and to have inferior Potatos than to have none? Besides, quality is very much a matter of storing. Interlayer the Potatos with earth and even miniature Potatos are not bad eating. As to rotting after lifting, this only happens when the lifting has been too long deferred. So harvest the crop before the disease hits the tubers, and it will not affect them afterwards. The testimony of experience is pretty uniform on this point. The apparent diversity of results in the sound keeping of early lifted Potatos has arisen from the disease being too

far advanced before they were harvested. If the seed of the disease has first reached the tubers, no doubt it will be developed into rottenness after lifting and storing, but not otherwise. Therefore the only chance of saving the bulk of the Potato crop is to harvest all that are fit and all that are in danger at once. Fortunately for the practicability of the course I am advocating the two terms are well nigh convertible. Potatos are fit to eat, almost fit to keep, before they are in much danger from disease. The Peronospora makes little progress until the plants approach maturity. Of course, these assertions are meant to be understood in a general sense, and in a sort of wholesale way. The exceptions, however, though at times they may be rather numerous, but confirm the rule. It is, therefore, practicable in most cases to harvest the crop between the period that elapses from the manifestation of the first symptoms to the destruction of the tubers.

As to the so-called new disease, it is in no symptoms and results at least as old as my recollections extend. If as Mr. Smith contends, it is our old foe in a new state, then is the Potato disease a much older malady than has generally been assumed. And I believe it is. No doubt it has become more general, and now and then it is developed into abnormal destructiveness; but facts and observations, could they be carefully collected, would probably confirm the natural inference that science could now draw from its knowledge of the pest—that the Peronospora, in some form of its manifold life, has clung to the Potato from or before its introduction into Europe. One or two points, however, do not seem to be made quite clear by Mr. Smith. If the destruction of the top is caused by this same pest in the new disease, why is the mode of destruction so different, and how is it that it stops short of the tuber? In the many cases of new disease that I have examined in cottagers' gardens over a wide area during the last week, not a single diseased tuber was found. The stem, roots, and in most cases the

old tubers of the Potatos, were entirely gone, but the Potatos whether large or small, were quite sound. Again, the old sets were not always rotten. Further, the disease does not seem to have any uniform time of development either as regards season of the year or state of plant. Potato plants in all stages of growth seem to have been attacked; hence sound tubers were found ranging in size from marbles to full-size Potatos, and the latter seem little if at all deteriorated in quality by the loss of the tops. In all these particulars the new disease seems identical in its effects with the old "curl," and no doubt tubers without tops, and roots of small tubers undeveloped or arrested by some cause, have been more or less common from the beginning of the cultivation of the Potato in Europe. The fact is quite familiar to all who have had experience in the lifting of Potatos, consequently I think we have little to fear from the new disease, excepting in so far as it may strengthen and multiply our old foe, the Peronospora infestans.

Mr. Smith's discoveries concerning the resting-spores of the latter would point to steeps for the seed, and frequent changes of ground for the crop, as the likeliest means of killing or starving out the disease. If it is possible to use steeps that will kill those resting-spores in or upon the Potatos without injuring the vitality of the seeds, we may thus rid ourselves of the pest. Again, if, as seems probable, the spores cannot rest more than a season, may it not be possible to starve out the Peronospora by growing such crops in succession to Potatos as the spores can neither vegetate nor develope into other forms upon ? A further knowledge of the likes and dislikes of the Peronospora in all its multiform modes or forms of life might enable us to select anti-Peronospora crops to starve or poison out the pest in all its stages. Unfortunately the cottager is almost always obliged, from the smallness of his holding, to grow Potatos after Potatos on some portion of his garden. This is doubtless a sure mode of perpetuating the Potato disease ;

and, indeed, it is found as a matter of actual observation and experience, that what is termed Potato-sick soil is that in which the disease has hitherto been most destructive, thus confirming, as it were beforehand, Mr. Smith's discoveries, that the earth is the hiding-place of the resting-spores; that in due time they are roused to life, perish if they cannot find a suitable matrix, such as the Potato plant, for their development, and run through their transformations and destroy the Potato crop, should it be within reach. It therefore follows that a total change of ground annually, which cultivators have found to be the best mode of insuring high quality, is also likely to prove the best safeguard against the Potato disease, old or new. *D. T. Fish.*

[We advise burning the whole of the haulm and decaying foliage as early as possible when attacked, instead of allowing it to rot, and thus deposit the resting-spores, fresh and sound, in the very best position for attacking the crop the following season. This might not get rid of all, but it would lessen their numbers, and therewith the chances of an attack. EDS.]

APPENDIX.

Some years ago when Secretary to the Mysore Planter's Association—Government favored me with a recipe for the cure of Foot and Mouth Disease in Cattle (Epizootic Aphtha discovered by Colonel H. N. Davies of the Burmah Commission.) I have never feared the disease since, and found the treatment and applications recommended an infallible cure. I regret to say I have mislaid my copy of the memorandum, but as I have extensively used the preparation and found it necessary slightly to alter the ingredients in order to utilize local products in compounding it, I will venture to state from memory "Wash the mouth and feet of the animal carefully with soap (Carbolic soap if procurable) and tepid water and apply the fruit salve freely to the tongue—gums—and whole interior of the mouth. Apply the lotion with a soft paint brush to the feet—being careful to see that a plentiful supply soaks well in through the division of the hoof. If maggots are visible they should be removed—though generally one application of the lotion is sufficient to destroy them—Separate the affected animals from the herd as the disease is highly contagious. Support strength with ragi gruel.

Salve.—Procure about 2 lbs. weight of very ripe Tamarinds. Free them from seeds and fibres and squeeze and work the fruit into a liquid pulpy mass adding about quarter of a seer of common salt.

Lotion.—In half a bucket of water dissolve a ball of country Catechu (karchu) (ಕಾಚು) (which is manufactured from the residue found after the boiling preparation of the areka nut) procurable in all bazaars—a tea spoonful of powdered alum (petticara) (ಬಿಳಿ ಪಟಿಕಾರ) and one or two drachms of Carbolic Acid,

While dealing with cattle and disease incidental to them, I may mention that in Mysore about October a disease closely resembling Murrain aften attacks the herds. I am not gifted with any technical knowledge as to the predisposing condition which induces this affection, but having read Dr. Shaw's Memorandum on Impaction of the Omasum, I gave strict attention to my herd at the particular season when the grass throws out a long seed stalk. For 15 or 20 days I kept all my cattle in the shed and fed them on straw, and although the village cattle were dying in dozens all around me, I had not one case of disease. I have now adopted this plan for several years with great success. I am led to believe that the grass at the particular period referred to, becomes not only bitter, but is little more than woody fibre, the gastic juices are unable to dissolve it and inflammation is the result. I have made several post mortem examinations and in each case found the folds of the maniplus completely obstructed and stuffed with the hard fibrous portions of this grass, all the other organs were also highly inflamed. I saved a few animals by giving them each a bottle of common castor oil and mixing saltpetre with their drinking water; but generally speaking the disease proved fatal. I saw one case treated successfully, with a drench composed of Calomel Condy's Fluid and gruel, but I fancy such a remedy meant "Kill or Cure." Asafœtida (ಇಂಗು) has also been used with a success. I strongly advocate prevention as at least more feasible than cure.

To kill maggots in wounds or sores in cattle there is nothing better than a pinch of Calomel, but if this is not at hand in the jungle, the leaves of the *wild* Tobacco (Toombay Suppoo) ತುಂಬೇ ಸಪ್ಪು) pounded on a stone with a little lime, will answer almost as well.

Average composition of Coffee beans adapted from the investigations of Payem and others.

Components, Equivalents, and properties.	
Cellulose—Cellular tissue—woody fibre—elementary organic matter	34·0
Water	12·0
Fat and essential oils—Nutricious and exhilarating.	13·0
Glucose Dextrine—Gum, sugar ...	15·5
Other *nitrogenous* substances ...	3·0
Caffeine—identical with Theine—prevents waste of animal tissue	·8
Legumin and Cassein—Equivalent to nutricious gluten or animal fibrin or albumen ...	10·0
Caffeo-tannic acid or Caffeotannate-of Caffeine with Potassium } Astringent principle ...	5·0
Ash	6·7
	100·0

Viscid essential oils insoluble in water Aromatic oils some heavier others lighter than water. } Empyreumatic—volatile oils—developed in roasting and constituting "Aroma."

NOTE.—Nutrition of plants extracted from the "Family Tutor."

"The organic substances essential to plants are cellulose and proteine; these enter into the structure of the smallest vegetable and are necessary to the formation of cells which are the first rudiments of organic development.

The food of plants consists of carbonic acid, water and ammonia in addition to mineral salts. These are absorbed by the organs of the plant and are converted into cellulose and proteine.

The cellular tissue is formed from the elements of carbonic acid and water by the separation of oxygen. In the formation of proteine the elements of ammonia are added to those of carbonic acid and water. Starch is identical in composition with cellulose and yields sugar and gum by combining with the elements of water."

Mechanical analysis of two samples of Munzerabad Coffee Estate soil......By Professor ANDERSON *of Glasgow.*

No. 1.

Gravel	none
Coarse sand ...	48·289
Fine sand	2·800
Clay	36·867
Organic Matter ...	12·044
	100·

No. 2.

Gravel	2·560
Coarse sand ...	78·176
Fine sand	1·799
Clay	3·201
Organic Matter ...	14·264
	·100

TABULAR STATEMENT OF THE COMPOSITION OF VARIOUS ARTICLES OF FOOD PROVING COFFEE TO BE OF GREAT NUTRITIVE VALUE.

Extracted from Johnston's Chemistry of Common Life.

Composition.	Beef.	Eggs.	Milk.	Wheaten Flour.	Oat-meal.
Fibrin, cassein, albumen or gluten	89	55	35	12	21
Fat	7	40	24	2½	7
Starch or Sugar ...	...	...	37	83½	70
Ash or mineral matter...	4	5	4	2	2
Totals...	100	100	100	100	100

COMPOSITION OF THE ASH OF COFFEE BERRIES.

As determined by Levi,—Herapath,—Stenhouse,—Graham,—and Campbell.

Extracted from Watt's Dictionary of Chemistry.

ANALYSIS.	Plantation Ceylon.	Wild Ceylon.	Java.	Costa Rica.	Jamaica.	Mocha.	Neilgheries.	Levi.	Herapath.	
Potash	55·1	52·1	54·0	53·2	53·7	54·6	55·8	50·9	16·5	
Soda	...	...	...	...	...	...	...	14·8	7·1*	*doubtful:
Lime	4·1	4·6	4·1	4·6	6·1	5·9	6·7	4·3	17·7	
Magnesia... ...	8·2	8·5	8·2	8·7	8·4	8·9	8·5	10·9	5·9	
Oxyde of Iron ...	0·45	0·98	0·73	0·63	0·44	0·44	0·61	0·6	...	
Sulphurous Acid,.	3·6	4·5	3·5	3·8	3·1	5·2	3·1	Trace	1·3	
Phosphoric Acid..	10·3	11·6	11·0	10·8	11·1	10·1	10·8	13·6	40·7	
Chlorine	1·0	0·5	0·8	1·0	0·7	0·6	0·6	1·2	0·4	
Silica	...	...	...	...	...	...	...	3·6	0·4*	*doubtful.
Carbonic Acid ...	17·5	16·9	18·1	16·9	16·4	17·0	14·9	...	...	